

**INVESTIGATION OF TECHNOLOGIES TO REDUCE EMISSIONS OF**  
**METHYLENE CHLORIDE FROM FURNITURE STRIPPING**  
**OPERATIONS**  
**Final Report**

Prepared By:  
Katy Wolf and Mike Morris  
Institute for Research and Technical Assistance  
Principal Investigator: Katy Wolf

Prepared For:  
California Air Resources Board and the California Environmental Protection Agency  
Under Contract Number 98-334

March, 2001

## **DISCLAIMER**

The statements and conclusions in this Report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

## ACKNOWLEDGMENTS

This report benefited considerably from the efforts of many persons within and outside the Institute for Research and Technical Assistance (IRTA). We would particularly like to acknowledge Benny Bixenman of Benco Sales and Cheryl Estill, James Jones, Robert Kurimo, Ronald Kovein and Daniel Watkins of the National Institute for Occupational Safety and Health. We would also like to thank Mike Garibay, Glenn Kasai and Ed Ramirez of the source testing staff of the South Coast Air Quality Management District. Thanks also go to Mohan Balagopalan, Jill Whynot and the modeling staff at the South Coast Air Quality Management District. We are grateful to Steve Church of the California Air Resources Board for his guidance and support during the project. We give special thanks to the owners and employees of the Strip Joint, Los Angeles Stripping & Finishing Center, Stripper Herk and Sunset Strip for their invaluable help with the project testing.

## TABLE OF CONTENTS

Disclaimer .....	i
Acknowledgments .....	ii
Table of Contents .....	iii
List of Figures .....	v
Abstract .....	vii
Executive Summary .....	viii
I. Introduction .....	1
II. Background on Furniture Stripping in California .....	4
Stripper Use .....	4
Table 2-1 Estimated Annual Stripper Usage .....	4
Wood and Coating Types .....	5
Regulations on Furniture Stripping Shops .....	5
OSHA Regulation .....	5
EPA Title V Operating Program .....	5
SCAQMD Rules .....	6
Technologies for Reducing METH Use/Emissions .....	6
Industry Description .....	7
Survey Results .....	12
Table 2-1: Survey Results--Stripping Equipment .....	12
Table 2-2: Survey Results--Ventilation Systems .....	13
Table 2-3: Survey Results--Reformulated Stripper .....	14
III. Tests of Alternative Strippers .....	15
Baseline Stripping Formulation .....	15
Alternative Stripping Formulations .....	15
NMP Product .....	16
NMP/Soy Gold Product .....	17
Soy Gold/TBAC Product .....	17
Low-METH Content Strippers .....	17
METH/NMP Product .....	17
METH/TBAC Product .....	18
METH/Soy Gold Product .....	18
METH/Propylene Carbonate .....	18
METH/NMP/TBAC/Soy Gold Product .....	18
Table 3-1: Strippers Tested during Project .....	19
Alternative Stripper Tests .....	20
Criteria for Stripping Formulations .....	21
Photographs from Initial Screening Stripper Tests at Strip Joint .....	22
Comparison of Alternative Strippers at Strip Joint .....	23
Photographs from Sunset Strip .....	23
Comparison of Alternative Strippers at Sunset Strip .....	24
Additional Longer-Term Alternative Stripper Tests .....	24
Results of the Longer-Term Stripper Tests .....	24
Alternative Stripping Formulation Ranking .....	25
IV. Ventilation System Testing .....	70
Ventilation System Testing at Strip Joint .....	70
Source Testing Procedure and Results .....	72
Table 4-1: Summary of Emissions and Capture Efficiency at Strip Joint .....	73
Ventilation System Testing at Sunset Strip .....	74
Source Testing Protocol and Results .....	77
Table 4-2: Summary of Emissions and Capture Efficiency at Sunset Strip .....	79
Discussion of Measurement Results .....	79

## TABLE OF CONTENTS CONT'D

V. Implications of Adopting Improved Ventilation Systems and Low-METH Content Strippers .....	81
Emissions Factor .....	81
MICR Reduction at the Nearest Receptor .....	82
Need for Cancer Risk Reduction .....	83
Risk Assessment Procedures .....	83
Table 5-1 Estimates of Cancer Risks Posed by Strip Joint and Sunset Strip Under Various METH Emissions Scenarios .....	86
Cost Analysis of Options .....	86
Strip Joint Ventilation System .....	86
Table 5-2 Annual Cost Comparison of Strip Joint Old and New Ventilation Systems .....	87
Sunset Strip Ventilation System .....	87
Table 5-3 Annual Cost Comparison of Sunset Strip Old and New Ventilation Systems .....	88
Use of Alternative Strippers .....	88
Table 5-4 Annual Comparative Cost of Baseline and Alternative Strippers for Typical Stripping Facility .....	89
Future Work .....	89
VI. Summary and Conclusions .....	91
VII. References .....	93
Appendix A MSDS for Baseline Stripper Benco #B7 Industrial Paint Remover .....	94
Appendix B MSDS for Alternative NMP Stripper B23B .....	97
Appendix C MSDS for Alternative NMP/Soy Gold Stripper CAE6 .....	99
Appendix D MSDS for Alternative Soy Gold/TBAC Stripper CAE8 .....	101
Appendix E MSDS for Alternative Low-METH NMP Stripper B25 .....	103
Appendix F MSDS for Alternative Low-METH TBAC Stripper CAE2 .....	106
Appendix G MSDS for Alternative Low-METH Soy Gold Stripper CAE3 .....	109
Appendix H MSDS for Alternative Low-METH Propylene Carbonate Stripper CAE4 .....	112
Appendix I MSDS for Alternative Low-METH NMP/TBAC/Soy Gold Stripper CAE7 .....	115
Appendix J SCAQMD Modeling Calculations for Strip Joint .....	118

## LIST OF FIGURES

Figure 2-1 Side View of a Typical Flow Tray.....	7
Figure 2-2 Top View of a Typical Flow Tray .....	8
Figure 2-3 View of a Typical Flow Tray and Formulation Drum .....	8
Figure 2-4 Flow Tray Ventilation System.....	10
Figure 2-5 Another View of Flow Tray Ventilation System.....	10
Figure 2-6 Typical Water Wash Booth.....	10
Figure 2-7 Typical Dip Tank.....	11
Figure 2-8 Dip Tank/Flow Tray Ventilation System.....	11
Figure 3-1 Cabinet Doors Stripped at Strip Joint .....	27
Figure 3-2 Chair Stripped at Strip Joint .....	27
Figure 3-3 Drawer with Pigmented Coating Stripped at Strip Joint.....	28
Figure 3-4 Drawer Stripped at Strip Joint .....	28
Figure 3-5 Worker Applying B7 Stripper at Strip Joint.....	29
Figure 3-6 Another View of Worker Applying B7 Stripper at Strip Joint.....	29
Figure 3-7 Worker Rinsing Chair at Strip Joint.....	30
Figure 3-8 Drawer Stripped with B7 Stripper at Strip Joint.....	30
Figure 3-9 Drawer Stripped with B7 Stripper at Strip Joint.....	31
Figure 3-10 Chair Stripped with B7 Stripper at Strip Joint.....	31
Figure 3-11 Chair Stripped with B7 Stripper at Strip Joint.....	32
Figure 3-12 Cabinet Doors Stripped with B7 Stripper at Strip Joint.....	32
Figure 3-13 Drawer Stripped with B7 Stripper at Strip Joint.....	33
Figure 3-14 Drawer Stripped with B23B Stripper at Strip Joint .....	33
Figure 3-15 Drawer Stripped with B23B Stripper at Strip Joint .....	34
Figure 3-16 Chair Stripped with B23B Stripper at Strip Joint .....	34
Figure 3-17 Chair Stripped with B23B Stripper at Strip Joint .....	35
Figure 3-18 Door Stripped with B23B Stripper at Strip Joint.....	35
Figure 3-19 Door Stripped with B23B Stripper at Strip Joint.....	36
Figure 3-20 Drawer Stripped with CAE6 Stripper at Strip Joint.....	36
Figure 3-21 Drawer Stripped with CAE6 Stripper at Strip Joint.....	37
Figure 3-22 Chair Stripped with CAE6 Stripper at Strip Joint.....	37
Figure 3-23 Chair Stripped with CAE6 Stripper at Strip Joint.....	38
Figure 3-24 Door Stripped with CAE6 Stripper at Strip Joint .....	38
Figure 3-25 Door Stripped with CAE6 Stripper at Strip Joint .....	39
Figure 3-26 Drawer Stripped with CAE8 Stripper at Strip Joint.....	39
Figure 3-27 Drawer Stripped with CAE8 Stripper at Strip Joint.....	40
Figure 3-28 Table Leg Stripped with CAE8 Stripper at Strip Joint .....	40
Figure 3-29 Door Stripped with CAE8 Stripper at Strip Joint .....	41
Figure 3-30 Door Stripped with CAE8 Stripper at Strip Joint .....	41
Figure 3-31 Drawer Stripped with B25 Stripper at Strip Joint.....	42
Figure 3-32 Drawer Stripped with B25 Stripper at Strip Joint.....	42
Figure 3-33 Chair Base Stripped with B25 Stripper at Strip Joint .....	43
Figure 3-34 Chair Stripped with B25 Stripper at Strip Joint.....	43
Figure 3-35 Door Stripped with B25 Stripper at Strip Joint .....	44
Figure 3-36 Door Stripped with B25 Stripper at Strip Joint .....	44
Figure 3-37 Drawer Stripped with CAE2 Stripper at Strip Joint.....	45
Figure 3-38 Drawer Stripped with CAE2 Stripper at Strip Joint.....	45
Figure 3-39 Chair Stripped with CAE2 Stripper at Strip Joint.....	46
Figure 3-40 Chair Stripped with CAE2 Stripper at Strip Joint.....	46
Figure 3-41 Door Stripped with CAE2 Stripper at Strip Joint .....	47
Figure 3-42 Door Stripped with CAE2 Stripper at Strip Joint .....	47
Figure 3-43 Drawer Stripped with CAE3 Stripper at Strip Joint.....	48

## LIST OF FIGURES CONT'D

Figure 3-44 Drawer Stripped with CAE3 Stripper at Strip Joint.....	48
Figure 3-45 Chair Stripped with CAE3 Stripper at Strip Joint.....	49
Figure 3-46 Chair Stripped with CAE3 Stripper at Strip Joint.....	49
Figure 3-47 Door Stripped with CAE3 Stripper at Strip Joint.....	50
Figure 3-48 Door Stripped with CAE3 Stripper at Strip Joint.....	50
Figure 3-49 Drawer with CAE4 Stripper at Strip Joint.....	51
Figure 3-50 Drawer Stripped with CAE4 Stripper at Strip Joint.....	51
Figure 3-51 Chair Stripped with CAE4 Stripper at Strip Joint.....	52
Figure 3-52 Chair Base Stripped with CAE4 Stripper at Strip Joint.....	52
Figure 3-53 Door Stripped with CAE4 Stripper at Strip Joint.....	53
Figure 3-54 Door Stripped with CAE4 Stripper at Strip Joint.....	53
Figure 3-55 Drawer Stripped with CAE7 Stripper at Strip Joint.....	54
Figure 3-56 Drawer Stripped with CAE7 Stripper at Strip Joint.....	54
Figure 3-57 Chair Stripped with CAE7 Stripper at Strip Joint.....	55
Figure 3-58 Chair Base Stripped with CAE7 Stripper at Strip Joint.....	55
Figure 3-59 Door Stripped with CAE7 Stripper at Strip Joint.....	56
Figure 3-60 Door Stripped with CAE7 Stripper at Strip Joint.....	56
Figure 3-61 Stripped Furniture Drying at Strip Joint.....	57
Figure 3-62 Flow Tray Used for Stripping at Sunset Strip.....	57
Figure 3-63 Another View of Flow Tray Used for Stripping at Sunset Strip.....	58
Figure 3-64 Water Wash Booth at Sunset Strip.....	58
Figure 3-65 Headboard before Stripping at Sunset Strip.....	59
Figure 3-66 Drawer before Stripping at Sunset Strip.....	59
Figure 3-67 Boat Step before Stripping at Sunset Strip.....	60
Figure 3-68 Drawer before Stripping at Sunset Strip.....	60
Figure 3-69 Door before Stripping at Sunset Strip.....	61
Figure 3-70 Drawer before Stripping at Sunset Strip.....	61
Figure 3-71 Items Stripped with B7 Stripper at Sunset Strip.....	62
Figure 3-72 Items Stripped with B7 Stripper at Sunset Strip.....	62
Figure 3-73 Items Stripped with B25 Stripper at Sunset Strip.....	63
Figure 3-74 Items Stripped with B25 Stripper at Sunset Strip.....	63
Figure 3-75 Items Stripped with B25 Stripper at Sunset Strip.....	64
Figure 3-76 Items Stripped with B25 Stripper at Sunset Strip.....	64
Figure 3-77 Items Stripped with CAE2 Stripper at Sunset Strip.....	65
Figure 3-78 Items Stripped with CAE2 Stripper at Sunset Strip.....	65
Figure 3-79 Items Stripped with CAE3 Stripper at Sunset Strip.....	66
Figure 3-80 Items Stripped with CAE3 Stripper at Sunset Strip.....	66
Figure 3-81 Stripping Door at Stripper Herk.....	67
Figure 3-82 Stripper Acting on Door at Stripper Herk.....	67
Figure 3-83 Items Drying at Stripper Herk.....	68
Figure 3-84 Stripping Carousel Horse at L.A. Stripping & Finishing Center.....	68
Figure 3-85 Applying Stripper to Carousel Horse at L.A. Stripping & Finishing Center.....	69
Figure 4-1 New High Air Flow Ventilation System on Flow Tray at Strip Joint.....	71
Figure 4-2 Ventilation System on Water Wash Booth at Strip Joint.....	71
Figure 4-3 Old Ventilation System at Sunset Strip.....	76
Figure 4-4 New High Air Flow Ventilation System on Flow Tray at Sunset Strip.....	76
Figure 4-5 Air Shower on Flow Tray at Sunset Strip.....	77
Figure 4-6 Ventilation System on Water Wash Booth at Sunset Strip.....	78

## **ABSTRACT**

This document describes the results of a project to investigate methods of reducing emissions of and the risk posed by methylene chloride (METH) emitted from furniture stripping facilities. METH is used in the stripping formulations used by these shops. Two methods of reducing the Maximum Individual Cancer Risk (MICR) at the nearest offsite receptor were investigated and analyzed. First, a baseline stripping formulation used by most stripping shops in California and eight alternative strippers with no or low-METH content were tested. Two of the low-METH content strippers performed well and their use could reduce the METH emissions from stripping shops by 29%. These alternative strippers may pose other risks that were not addressed in the report. Second, higher air flow ventilation systems were tested to determine whether they could capture the METH emitted from the stripping process. One of the higher air flow ventilation systems, a 1500 cfm system, achieved a 60 to 70% capture efficiency. The other system, a 3000 cfm system, achieved a 90% capture efficiency. It is estimated that these systems would reduce the exposure to METH at the nearest offsite receptor by 13 to 17%. The MICR reduction at the nearest offsite receptor that could be achieved by combining a high air flow ventilation system and a low-METH content stripper is estimated at 40%.



## EXECUTIVE SUMMARY

### BACKGROUND

Furniture stripping shops are small facilities that strip wood furniture and other wood items as a service. Some of these stripping facilities also repair and paint the wood furniture after stripping. Virtually all furniture strippers are small businesses with fewer than five employees.

Furniture stripping firms use methylene chloride (METH) based stripping formulations to remove a variety of different types of coatings from furniture that is made of a range of different woods. There may be as many as 80 stripping shops in California that use more than 700 gallons per year of METH based stripper and have equipment for efficiently performing stripping.

METH is classified as a Toxic Air Contaminant in California and is listed on Proposition 65. The chemical is a suspect carcinogen and companies that use it pose a high risk to workers and to the surrounding community. The California Air Resources Board (CARB) and local air districts in the state are interested in identifying methods that could be effective in minimizing the risk posed by stripping facilities. In that light, the Institute for Research and Technical Assistance (IRTA) conducted a project to investigate two methods of reducing the risk. One of the methods that was examined during the project is use of alternative low- and non-METH stripping formulations. Another method that was examined was use of high air flow ventilation systems.

### METHODS

The stripping formulation used by most furniture strippers contains about 80% METH. IRTA arranged for eight alternative low- and non-METH strippers to be formulated and these alternative strippers were tested in four stripping facilities in the South Coast Basin. Six of the stripping formulations did not perform well. Two of the alternative low-METH strippers did perform well and both of these strippers contained less than about 50% METH. The two best performing strippers were tested more extensively in one facility to determine whether they kept their composition over time. The stripper composition did not change and one of them was selected for additional testing with the higher air flow ventilation systems.

In an earlier project sponsored by the National Institute for Occupational Safety and Health (NIOSH), IRTA arranged for two higher air flow ventilation systems to be designed and installed in two Southern California stripping facilities. These systems were tested to determine if they could meet more stringent worker exposure regulations established by the Occupational Safety and Health Administration (OSHA). One of the systems, rated at 1500 cfm, did not control the worker exposure adequately but the other system, rated at 3000 cfm, was capable of reducing the worker exposure level to the OSHA action level.

During this project, IRTA arranged for the South Coast Air Quality Management District (SCAQMD) to perform source testing to determine whether the two higher air flow ventilation systems could reduce the Maximum Individual Cancer Risk (MICR) at the nearest offsite receptor (assumed to be 25 meters from the source of METH emissions) posed by stripping facilities. The source testing involved measuring the METH emission rate during stripping and determining the capture efficiency of the ventilation systems. The baseline stripper containing 80% METH was tested and the best performing alternative stripper was also tested. In one of the stripping facilities, the effectiveness of

the higher air flow ventilation system in capturing METH emissions was compared to the effectiveness of the older low air flow system.

Using the results of the alternative stripper testing and the results of the ventilation system source testing, IRTA estimated a METH emissions factor for this industry. IRTA also performed risk assessment calculations using a look-up table method devised by SCAQMD from earlier source tests at furniture stripper sites to estimate the reduction in exposure of METH emissions at the closest offsite receptor using the alternative strippers and the higher air flow ventilation systems. Finally, IRTA performed a cost analysis to assess the cost impacts of requiring use of alternative strippers and/or more expensive ventilation systems.

## RESULTS

The best alternative low-METH stripper was tested during the source testing. The source test results indicated that use of this stripping formulation reduced emissions of METH by 29%. Since exposure to METH emissions is directly proportional to risk, use of the stripper would also reduce the risk by 29%. This stripping formulation contains n-methyl pyrrolidone (NMP) in place of METH. NMP is a reproductive and developmental toxin that may soon be added to Proposition 65. Although use of this stripper reduces the carcinogenic risk of METH, the reproductive or developmental toxicity risk could be increased.

High air flow ventilation systems can reduce the MICR to the closest offsite receptor because they capture the METH emissions and send the METH emissions out a higher stack. The source testing results indicated that use of the 1500 cfm higher air flow ventilation system was able to capture 62 to 70% of the METH emissions. This can be compared with the 22% capture efficiency of the older ventilation system. The capture efficiency of the 3000 cfm ventilation system was even higher, at about 90%; in this case, the older ventilation system only captured 40% of the METH emissions. IRTA estimated the MICR reduction at the nearest offsite receptor that can be achieved with use of the higher air flow ventilation systems at 13 to 17%.

IRTA estimated the MICR reduction at the nearest offsite receptor that could be achieved through use of both the low-METH alternative stripper and the higher air flow ventilation systems. Use of the 1500 cfm ventilation system and the low-METH content stripper reduced the MICR due to METH emissions at the nearest offsite receptor by 38%. Use of the 3000 cfm ventilation system and the low-METH content stripper reduced the MICR due to METH emissions at the nearest offsite receptor further, to 41%.

A typical stripping facility makes a profit of about \$30,000 annually. The limited cost analysis performed during this project indicated that shops would incur a cost of between \$900 and \$1,400 per year if they purchased a higher air flow ventilation system. Use of the alternative stripper could increase costs by \$800 to \$900 per year. Use of both methods could increase the cost to a typical facility by 6 to 9% of profits.

## CONCLUSIONS

Furniture strippers are small businesses that emit substantial quantities of METH, a suspect carcinogen. Two methods of reducing the exposure to METH emissions at the nearest offsite receptor posed by stripping facilities were investigated. If use of higher air flow ventilation systems and alternative low-METH content strippers were mandated by local air districts for stripping facilities, the MICR at the nearest offsite receptor due to

METH emissions could be reduced by about 40%. Stripping facilities would increase their costs by about 6 to 9% of their current annual profits of \$30,000.

## I. INTRODUCTION

The Institute for Research and Technical Assistance (IRTA) received a contract from the California Air Resources Board (CARB) in September 1999 to conduct a project with furniture stripping facilities in California. The CARB project was designed to investigate methods of reducing the exposure to methylene chloride (METH) emissions posed by furniture stripping firms in California to the surrounding community. The contract involved testing several alternative stripping formulations in four stripping facilities in Southern California. The project also involved designing and installing higher air flow ventilation systems in two stripping facilities and conducting source testing to determine the impacts of capturing and expelling toxic emissions from ventilation stacks.

The component of concern in the stripping formulation most widely used by furniture stripping shops today is methylene chloride. The chemical is a suspect carcinogen and is classified as a Hazardous Air Pollutant (HAP) by EPA and a Toxic Air Contaminant (TAC) by the state of California. On January 10, 1997, the Occupational Safety and Health Administration (OSHA) finalized a rulemaking that lowered the permissible exposure level (PEL) of METH in the workplace from 500 ppm to 25 ppm.

The Maximum Individual Cancer Risk or MICR is defined and discussed in more detail in Section V. Briefly, the MICR is defined as the estimated probability of a potential maximally exposed individual contracting cancer as a result of exposure to toxic air contaminants over a period of 70 years for residential and 46 years for worker receptor locations.

Two methods of reducing the MICR at the nearest offsite receptor 25 meters from the source of stripping emissions posed by the METH strippers were examined during this project. The first method is to reduce or eliminate the METH content of the strippers. This involved reformulating strippers and testing the new strippers under field conditions. A reduction in the METH content of the strippers leads to a decrease in emissions of METH. The second method is to increase the air flow and effectiveness of the ventilation systems in stripping facilities. This leads to a reduction of the MICR at the nearest offsite receptor from METH emissions.

IRTA conducted two earlier projects that are directly related to the CARB project. The first, sponsored by the South Coast Air Quality Management District (SCAQMD), involved performing a survey of furniture strippers in the South Coast Basin and determining their stripping practices and the quality of their ventilation systems. The second, sponsored by the National Institute for Occupational Safety and Health (NIOSH), involved testing alternative strippers and designing, installing and testing high air flow ventilation systems to determine if they can effectively reduce worker exposure to the METH strippers.

Several organizations contributed to the work during the CARB project. Benco Sales, a stripping formulation and equipment supplier, formulated all the alternative strippers that were tested and built the new higher air flow ventilation systems. NIOSH staff assisted in the design of the ventilation systems. The SCAQMD staff performed source testing to compare the emissions of METH to the surrounding community of the baseline and alternative strippers and the existing and new ventilation systems. IRTA assisted Benco Sales in the design of alternative strippers, identified the facilities for testing, helped devise test plans, assisted in the short- and long-term testing of the alternative strippers and the testing of the ventilation systems and analyzed the results of the testing.

This document summarizes the results of the alternative stripper and ventilation system testing. Section II provides background information on the furniture stripping industry and specifically, the facilities in the Southern California area, the stripping formulations the industry uses and the regulations that apply to the industry. It also includes some of the results of the survey data from the earlier SCAQMD project. Photographs of the equipment and ventilation systems currently used in some of these facilities are provided. Section III describes the alternative strippers that were tested in four stripping facilities and summarizes the results of the comparative stripper tests. Section IV describes the ventilation systems that were constructed and tested in two stripping facilities. It also discusses the results of the ventilation system testing. Section V develops an emissions factor for METH for this industry, analyzes the MICR reduction at the nearest offsite receptor that can be achieved through adoption of alternative low-METH strippers and higher air flow ventilation systems and presents a cost analysis for stripping facilities to implement the new strippers and ventilation systems. The last section, Section VI, summarizes the results of the testing and research.

The results indicate that there could be as many as 248 firms that use METH based strippers for stripping wood furniture and other items in the Southern California area around Los Angeles. There are about 38 firms that have stripping equipment and use more than 200 gallons of stripper annually. There could be as many as 80 facilities in California that have stripping equipment and use relatively large quantities of stripper.

The tests of the alternative stripping formulations indicate that the best performing alternative strippers were two low-METH blends. Some of the alternative strippers that were tested performed well on certain types of coatings. The two best performing low-METH strippers, however, were more consistent than the other alternative strippers in their capability to effectively remove all kinds of coatings in a timely manner. These strippers also performed well in longer-term tests. As described later in Section III, each of the two best performing strippers contains a non-METH solvent that poses toxicity problems. In Section V, it was estimated that use of the alternative strippers could reduce the emissions of METH and consequently the MICR at the nearest offsite receptor due to stripping shops by 29%.

None of the furniture stripping facilities in Southern California had effective ventilation systems. Higher air flow and more effective ventilation systems were built, installed and tested in three facilities during IRTA's earlier NIOSH project. Two of the higher air flow systems were tested during this project to determine the extent to which they could be effective in reducing the MICR at the nearest offsite receptor. One of the ventilation systems, the lower cost system, was capable of capturing between 60 and 70% of the METH emitted from stripping operations. A second more expensive ventilation system was capable of capturing about 90% of the METH emitted from stripping operations. The results indicated that these systems have good potential for reducing the MICR at the nearest offsite receptor due to METH emissions. It was estimated that the reduction in the MICR at the nearest offsite receptor that could be achieved through use of these systems is between 13 and 17%.

One of the best low-METH alternative strippers was also tested with the old and new higher air flow ventilation systems. Total stripper METH emissions of the alternative stripper were lower than METH emissions of the baseline stripper. This is because the alternative stripper contained between 50 and 60% METH whereas the baseline stripper contained about 80% METH. The alternative stripper tests also indicated that the total volume of alternative stripper that was used is lower than that of the baseline. This is because the vapor pressure of the alternative stripper is much lower than the vapor pressure of the baseline stripper. Because the two best alternative stripping formulations

contain other materials that may be toxic, use of the alternatives may increase the risk of different toxicity endpoints.

The MICR at the nearest offsite receptor posed by a typical facility probably cannot be reduced to 25 in a million, the MICR threshold level specified in the SCAQMD rule that regulates toxic emissions from existing facilities. Even so, use of the two methods for reducing exposure to METH emissions at the nearest offsite receptor could have a significant impact on lowering that MICR location. The testing and analysis indicate that the MICR reduction at the nearest offsite receptor due to METH emissions could be achieved through use of both an alternative low-METH stripper and a higher air flow ventilation system in the order of 40%.

The SCAQMD plans to develop a technology-based regulation for the furniture stripping industry in 2002 as part of their risk reduction strategy. A limited cost analysis was performed here to determine the effects on stripping shops of a regulation that required the adoption of low-METH strippers and high air flow ventilation systems. The results indicate that these shops would incur an increased cost that represents between 6 and 9% of their profits.

## II. BACKGROUND ON FURNITURE STRIPPING IN CALIFORNIA

There may be as many as 250 firms in a four county area (Los Angeles, Orange, San Bernardino and Riverside Counties) that strip, repair and refinish wood furniture and other wood items. The Southern California area accounts for about half the stripping facilities in the state which indicates that there may be about 500 stripping facilities statewide. These firms are virtually all small businesses with one to five employees. Some of the companies perform only stripping; others have both stripping and refinishing operations.

The largest strippers use equipment to apply the stripper. The most widely used type of equipment is the flow tray which is a shallow sloped tray with a drain at one end. The stripper is applied with a pump and a brush. A few strippers use dip tanks instead of a flow tray to strip furniture. Some shops have both a dip tank and a flow tray. The vast majority of strippers use very little stripper and they apply it by hand either in a coating booth, outside or in their facility without ventilation. The physical details of the stripping operation are described in more detail later.

### STRIPPER USE

The use of stripper varies widely from firm to firm. Table 2-1 provides estimates of the stripper usage for the industry using the assumption that there are 248 firms that perform stripping in the Southern California Basin and twice that number in the state. The survey results from the earlier SCAQMD project indicated that 248 firms in the Basin used METH formulations for stripping. Perhaps two or three of the largest strippers use more than 1,200 gallons of stripper per year. An estimated 15 strippers use between 700 and 1,200 gallons of stripper annually. About 20 strippers use between 200 and 700 gallons per year. The smallest strippers, about half of the firms in the Basin, use less than 5 gallons of stripper per year. The remaining strippers, 86 of them, use between 5 and 200 gallons of stripper per year.

Assuming that the South Coast Basin accounts for about half the strippers in the state, the statewide distribution might be expected to be similar. On this basis, there may be as many as 496 stripping facilities in California. Perhaps six of those stripping facilities use between 1,200 and 2,000 gallons of stripper annually and 40 of them use between 700 and 1,200 gallons of stripper per year. The vast majority of the stripping facilities use less than five gallons of stripper per year.

**Table 2-1**  
**Estimated Annual Stripper Usage**

Annual Stripper Usage (gallons per year)	Number of Firms in South Coast Basin	Number of Firms in California
1,200 - 2,000	3	6
700 - 1,200	15	30
200 - 700	20	40
5 - 200	86	172
< 5	124	248
Total	248	496

## WOOD AND COATING TYPES

Various types of woods are used to make wood items and furniture. A variety of coating types are also used on the woods. The most important factor in the stripping process is the type of coating that needs to be stripped. Stripper effectiveness is determined by its ability to strip the coating and the wood type is comparatively unimportant.

The most common type of coating that requires stripping today is the conventional solventborne coating. This type of coating represents more than 50% of the coatings that require stripping by furniture strippers. Between 20 and 30% of the coatings encountered are conventional clear varnishes which include shellacs. Cross-linked clear finishes that also fall into this category have begun to be used over the last 15 or 20 years. Waterborne latex and acrylic coatings and high performance cross-linked pigmented and clear coatings account for the remaining 15 to 20% of the finishes encountered by furniture strippers today.

The waterborne, cross-linked and pigmented coatings are more difficult to strip than the traditional solventborne lacquers. The mix of coatings furniture strippers encounter will change in the future because of the regulations requiring greater use of low VOC coatings. Furniture strippers must be able to rely on effective strippers capable of removing a wide range of coatings.

## REGULATIONS ON FURNITURE STRIPPING SHOPS

The companies that perform stripping in California are faced with regulations at the federal and local/state level.

### OSHA Regulation

On January 10, 1997, the Occupational Safety and Health Administration (OSHA) finalized a regulation on methylene chloride that was under development for 10 years. It lowered the Permissible Exposure Level (PEL) of methylene chloride from 500 ppm to 25 ppm over an 8-hour time-weighted average (TWA). The regulation established a Short-Term Exposure Limit (STEL) of 125 ppm; the previous STEL was set at 1,000 ppm.

The regulation also established a so-called action level of 12.5 ppm. If the workers' exposure exceeds 12.5 ppm, the employers must institute exposure monitoring and medical surveillance. If the exposure is above the action level, monitoring is required every six months; if the exposure is above the PEL, monitoring is required more often, every three months. Where the action level is exceeded, the employees with exposure to METH for more than 30 days per year must see a health care provider and this must be paid for by the employer.

### EPA Title V Operating Program

Title V is a federal program that requires certain sources to obtain an operating permit and to provide notification of significant changes in that permit. Sources that have the potential to emit more than 10 tons per year of an individual HAP or 25 tons per year of combined HAPs are subject to the program. In most air district jurisdictions, actual emissions of an individual HAP that are between 4.5 and 8 tons per year could be pulled into the program. Some of the largest furniture strippers--those emitting more than about 900 gallons of stripper per year--could be required to obtain a Title V permit.



## SCAQMD Rules

The SCAQMD rule that regulates stripper used by furniture stripping firms in Southern California is Rule 1136 "Wood Products Coatings." It limits strippers to those with a Volatile Organic Compound (VOC) content of 350 grams per liter of material or less or those that have a composite vapor pressure of 2 mm Hg or less. METH is not classified as a VOC; the other components in stripping formulations are the contributors to the VOC content of the stripper. Many of the other local air districts in California have regulations that have requirements similar to SCAQMD Rule 1136.

Another SCAQMD rule that has had a substantial effect on furniture stripping firms in Southern California is Rule 1401 "New Source Review of Carcinogenic Air Contaminants." This rule contains a list of chemicals that are considered carcinogens, including METH. New firms and firms that relocate or modify their operation that use one of the listed chemicals are covered by the rule requirements. The rule requires that the MICR posed by the facility not exceed 1 in a million. If the facility installs Toxics Best Available Control Technology (T-BACT), then the MICR must not exceed 10 in a million. The Maximum Individual Cancer Risk or MICR is defined in Rule 1401 as the estimated probability of a potential maximally exposed individual contracting cancer as a result of exposure to toxic air contaminants over a period of 70 years for residential and 46 years for worker receptor locations.

SCAQMD Rule 1402 "Control of Toxic Air Contaminants from Existing Sources" affects existing stripping shops. Rule 1402 requires that existing facilities reduce MICR to no more than 25 in a million. Currently, Rule 1402 applies to larger AB2588 facilities and all of these facilities have prepared and submitted risk assessments to the District. An additional 7,500 facilities in the South Coast Basin are likely to pose an MICR higher than 25 in a million. Because there are so many of these facilities and because many of them are small businesses, the District will not require them to perform risk assessments. The SCAQMD plans to develop technology based industry specific regulations for several industries including furniture strippers. The furniture stripping regulation will be developed in 2002.

Other local air districts in the state have toxics policies and regulations. These policies and regulations affect the METH emissions from furniture stripping facilities.

## TECHNOLOGIES FOR REDUCING METH USE/EMISSIONS

The aim of the project described here was to identify and test technologies for reducing the MICR at the nearest offsite receptor posed by furniture stripping facilities. Two methods that accomplish both of these aims are available and they were both investigated during this project.

First, the MICR can be reduced through the use of strippers that do not contain METH or contain lower concentrations of METH thereby reducing emissions of METH. Second, exposure to METH emissions at the MICR location can be reduced through use of effective high air flow ventilation systems. Such systems capture METH emissions from the stripping operations and send emissions out the ventilation stack(s). The nearest offsite receptor 25 meters from the stripping source is exposed to a lower concentration of METH and the MICR at that receptor is lower. The work that was performed during this project to investigate the effectiveness of these methods is described in Section III and Section IV.

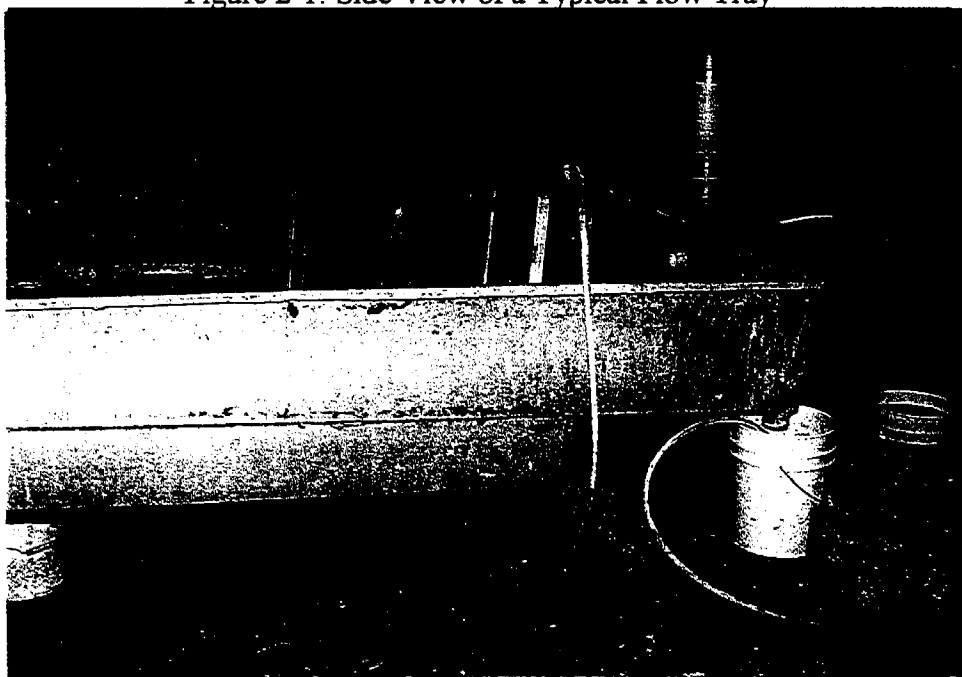
## INDUSTRY DESCRIPTION

As part of IRTA's earlier project for SCAQMD, IRTA conducted a survey of furniture strippers in the Southern California area to determine their current practices and their future plans. Some of the survey results are presented here to serve as a background description of the industry.

One of the sections of the questionnaire was designed to determine what types of equipment the stripping firms used to strip the wood furniture and other wood items. As mentioned earlier, most stripping shops use a flow tray for stripping the furniture. Dip tanks are sometimes used for primary stripping but often they are used to soak items that are difficult to strip. After these items have been soaked, they are generally placed in the flow tray for stripping.

Figures 2-1 through 2-3 show various views of a flow tray used in a typical stripping operation. It is a sloped shallow tank eight feet long and four feet wide with a drain at the lower end. The stripper is pumped through a brush from a five gallon container. The item to be stripped is placed in the tray and the worker moves the brush over the part vigorously. At times it is necessary to scrape the item to completely remove the coating.

Figure 2-1: Side View of a Typical Flow Tray

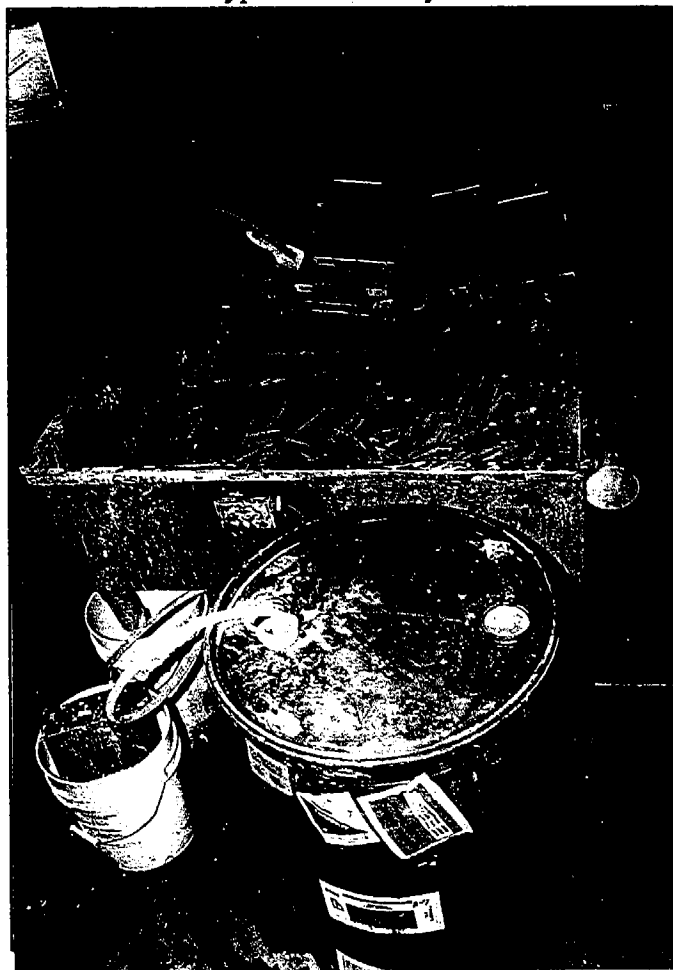


Figures 2-4 and 2-5 show photographs of a typical ventilation system that is connected to a flow tray. Figure 2-4 shows a top view of the flow tray with the ventilation system hook-up. There are several vent ports along the back of the flow tray that draw the METH-laden air from the front of the flow tray, where the worker stands, to the back of the tray. In other words, the air is drawn away from the worker to prevent exposure. The air is collected in a four-inch vent pipe and is exhausted, with a blower, through a duct out of the facility. Figure 2-5 shows another view of the flow tray.

Figure 2-2: Top View of a Typical Flow Tray



Figure 2-3: View of Typical Flow Tray and Formulation Drum



When the worker is finished stripping the wood item, it is transferred to the water wash booth. Figure 2-6 shows a typical water wash booth. High pressure spray wands containing water and oxalic acid are used to rinse the remaining stripper and coating residue from the item. The oxalic acid is used to brighten the wood surface. On the left hand wall of the water wash booth, the duct to the vent system is clearly visible in Figure 2-6.

Some furniture stripping shops use a dip tank instead of a flow tray for stripping. In these cases, the dip tank has a sloped cover on which the item to be stripped is placed. A pump delivers the stripper to the item and the residual stripper flows back into the dip tank. Some stripping firms have both a flow tray and a dip tank. In this case, the dip tank is used to pre-soak certain wood items that have tough coatings. When the item is ready to be stripped, it is moved to the flow tray and stripped as described above. The dip tank, in this case, is also used as a repository for the used stripper from the flow tray.

Figure 2-4: Flow Tray Ventilation System



Figure 2-5: Another View of Flow Tray Ventilation System

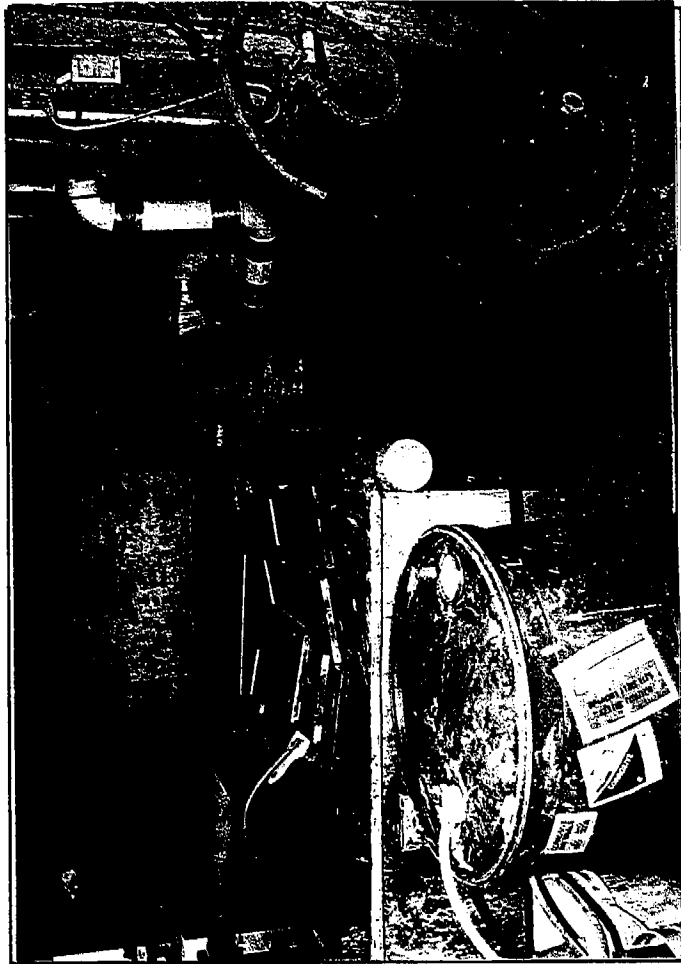
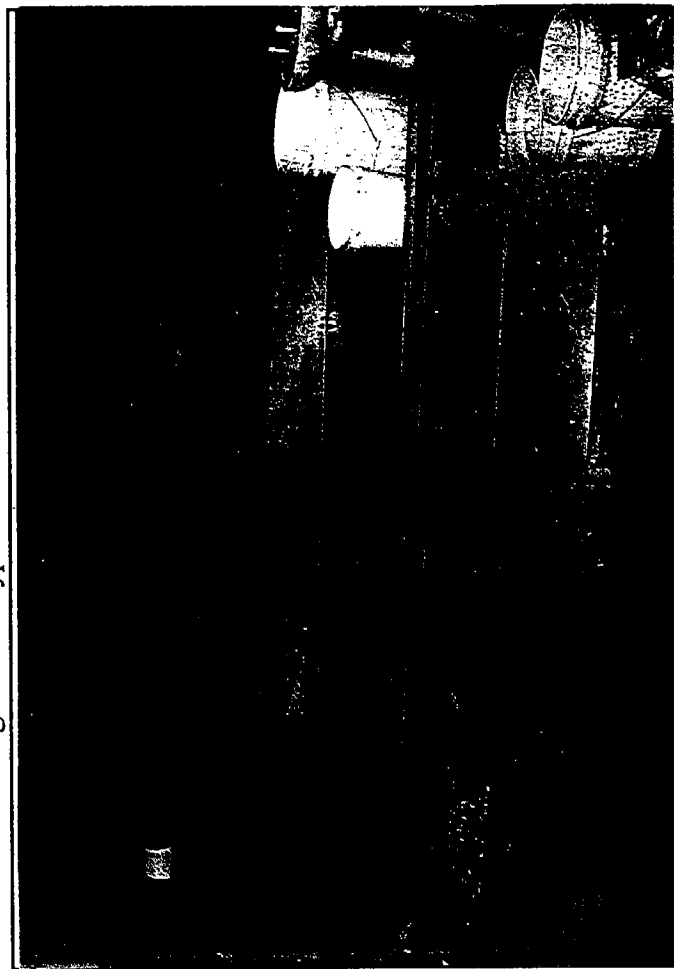


Figure 2-6: Typical Water Wash Booth



Figures 2-7 and 2-8 show a dip tank from a facility that has both a flow tray and a dip tank. The dip tank has a recessed lid. When the lid is opened, if the tank has a ventilation system, the blower draws air from the tank. In this case, the dip tank is connected to a vent system as shown in Figure 2-7. Figure 2-8 shows a view of the ventilation system connected to both the dip tank and a flow tray.

Figure 2-7: Typical Dip Tank

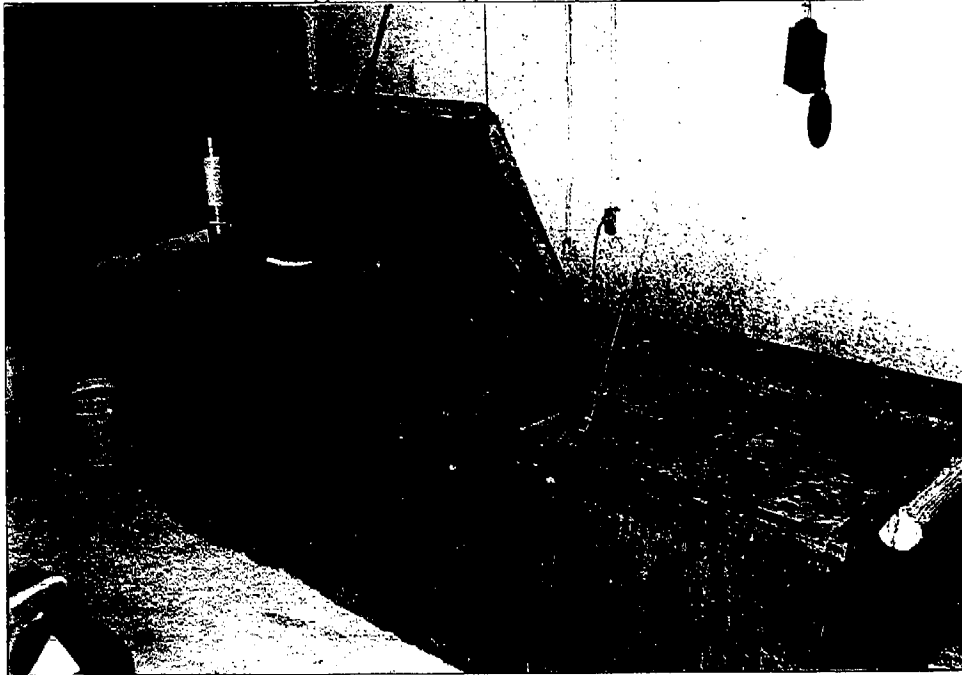


Figure 2-8: Dip Tank/Flow Tray Ventilation System



## SURVEY RESULTS

The survey for IRTA's SCAQMD project was mailed to 397 firms located in the four-county area of the South Coast Basin. Of these, 18 were duplicates or were not viable businesses. This left a total of 379 firms that were surveyed. IRTA received fourteen of the surveys back. IRTA staff then placed telephone calls to the remaining strippers to fill out the survey information for the firms. Of the 379 businesses, IRTA did not obtain survey responses from 214. IRTA was not able to contact some of these, some did not return phone calls and some refused to answer the questions. Of the 379 firms surveyed, 165 ended up providing information to complete the surveys. This represents 44% of the surveyed population.

Of the 165 firms surveyed, 57 of the firms or about 35%, did no stripping. This left 108 firms or 65% that conduct stripping operations. Some 214 facilities did not respond to the survey. Assuming the same percentages as for the 165 survey respondents, this would add an additional 140 firms that conduct stripping. The total number of firms that conduct stripping in the Basin could amount to 248.

Of the 108 firms that responded to the survey and performed stripping, 24 used a flow tray only for stripping, 8 used both a flow tray and a dip tank and 3 used a dip tank only. The total number of firms that used equipment was 35 which represented 32% of the survey respondents. The larger more sophisticated strippers would be more likely to respond to the survey. It is doubtful that the percentage of the remaining firms with equipment is as high as the percentage of the survey respondents. Industry sources place the number of firms that have equipment at about 50.

The firms that do not have equipment reported that they applied the stripper by hand in various locations in the facility. Some indicated that they stripped outside; others reported that they stripped inside the facility; still others indicated that they stripped inside a coating booth.

The survey results on the types of equipment used by furniture strippers are summarized in Table 2-1.

**Table 2-1**  
**Survey Results--Stripping Equipment**

# Surveys sent	379
# Survey respondents	165
# Firms that perform stripping	108
# Firms with flow trays only	24
# Firms with dip tanks only	3
# Firms with flow tray and dip tank	8
Total number of firms with equipment	35

Of the 24 facilities that perform stripping in a flow tray only, 10 did not have a ventilation system. Of the remaining 14 facilities, 11 indicated that they did not know the horse power of the blower. Of the remaining 3, one indicated the shop had a 1 horse power blower which would suggest an 800 to 2,000 cfm ventilation system. The other two indicated their shops had a 5 and 15 horse power blower which are obviously incorrect.

Of the 3 facilities that have dip tanks only, one reported having no ventilation system. Of the remaining two shops, one did not know the blower horsepower and the other indicated the ventilation system had a one-half horsepower blower which would suggest a 500 to 1,000 cfm system.

Of the 8 firms that used both a flow tray and a dip tank, 6 had vents on the flow tray and 5 of the 6 also had vents on the dip tank. Three of these also had vents on the water wash booth. In all cases, the horse power of the blowers on the flow tray and the dip tank in the facilities was the same. One facility did not know the horsepower of the blower. Two facilities had one-half horsepower blowers, 2 had three-fourths horsepower blowers and 1 had a one horse power blower.

Of the facilities that have stripping equipment (flow trays or dip tanks), 11 indicated they would be willing to purchase new higher air flow ventilation systems, 21 indicated they would not be willing to purchase new systems and 3 did not know.

The survey results on the ventilation systems are summarized in Table 2-2.

**Table 2-2**  
**Survey Results--Ventilation Systems**

# Survey respondents with equipment	35
# Firms with flow tray only	24
# That have ventilation system	14
# Firms with dip tank only	3
# That have ventilation system	2
# Firms with flow tray and dip tank	8
# That have ventilation system on flow tray	6
# That have ventilation system on dip tank	5
# Firms that would be willing to purchase better ventilation equipment	11

The third section of the questionnaire focused on whether firms would be willing to adopt new low-METH formulations. The survey asked if shops would be willing to pay 10%, 20% or 50% more. Of the 108 facilities that performed stripping, 20 indicated they did



not know whether they would be willing to adopt an alternative formulation, 13 indicated they would not and 75 indicated that they would adopt an alternative stripper. Of these 75 facilities, 26 said they would pay 10% more, 14 said they would pay 20% more and 5 said they would pay 50% more. The remaining 30 facilities said they would not pay more for alternative formulations.

The survey results on alternative strippers are summarized in Table 2-3.

**Table 2-3**  
**Survey Results--Reformulated Stripper**

# Firms that perform stripping	108
# Firms that would not adopt alternative stripper	13
# Firms that did not know	20
# Firms that would adopt alternative stripper	75
# Firms that would not pay more	30
# Firms that would pay 10% more	26
# Firms that would pay 20% more	14
# Firms that would pay 50% more	5

The results of the survey indicate that only about 38 stripping shops in Southern California are large enough to use equipment for stripping. It is likely that these companies use a larger amount of stripper than facilities without equipment. These companies are the ones that pose the highest MICR.

The survey results also indicate that most stripping companies with equipment have inadequate, if any, ventilation systems. Higher air flow ventilation systems might be effective in dispersing emissions of METH from the ventilation stack(s) resulting in a reduction in the MICR at the nearest offsite receptor due to emissions of METH.

The survey results indicate that many firms would be willing to adopt an alternative stripper. In some cases, these companies would even be willing to use an alternative stripper that was more costly than the stripper they use currently. Use of alternative low- or non-METH strippers is potentially an effective method of reducing emissions of METH thereby reducing cancer risk these facilities pose.

### III. TESTS OF ALTERNATIVE STRIPPERS

A baseline and eight alternative stripping formulations were tested in two furniture stripping facilities during the project. The best performing two alternative strippers were further tested in four stripping shops to determine their longer-term viability. One of the criteria for alternative strippers tested during this project was that they meet the VOC levels set by SCAQMD Rule 1136 so they could be used legally in Southern California. Since many other air districts in the state use the same standards as the SCAQMD, they could likely be used in other parts of California as well. This means that the strippers must contain 350 grams per liter or less VOC or have a vapor pressure less than 2 mm Hg. A second criterion was that the alternative strippers were limited to those approved by the fire departments. Many flammable strippers would be discarded on this basis. The third criterion was that the alternative strippers could not be clearly more toxic than the methylene chloride baseline stripper. As discussed below, it is difficult to compare the toxicity of some of the stripper components with the toxicity of METH. This section discusses the baseline stripping formulation, the alternative strippers that were tested, the testing conditions and the results of the stripping tests.

#### BASELINE STRIPPING FORMULATION

The stripper most commonly used today by most firms has the following approximate composition:

- 70 to 85% METH
- 8 to 15% methanol
- 5 to 10% other ingredients

The METH is the active agent that penetrates the coating film and lifts the coating from the surface of the wood. The methanol acts synergistically to enhance the stripping capability of the METH. The other ingredients include other VOC solvents, surfactants to make the stripper rinseable and wax to hold the volatile METH on the surface long enough to strip the coating.

The stripping formulation that served as the baseline stripper for the tests of alternative strippers that were conducted for this project is made by Benco Sales. A Material Safety Data Sheet (MSDS) for the stripper, called Benco #B7 Industrial Paint Remover, is included in Appendix A. This particular stripping formulation is blended by the firm that sells stripper to most of the furniture strippers in Southern California.

The MSDS for the baseline stripper, called B7, indicates that the VOC content of the stripper is 244 grams per liter. This meets the SCAQMD Rule 1136 limit for VOC content.

#### ALTERNATIVE STRIPPING FORMULATIONS

Several classes of alternative stripping formulations have been investigated and tested over the years. These can generally be categorized as flammable strippers, combustible strippers and low-METH content strippers. Flammable and combustible strippers--strippers that contain no METH--have received the most attention as potential alternatives in the past.

Flammable strippers commonly consist of blends of low flash point solvents including acetone and methanol. One problem with these strippers is that they are dangerous

because of the flammability. In fact, most fire departments will not allow the use of these stripping formulations in flow trays or dip tanks. Another problem with these strippers is that they are not very effective. No flammable strippers were tested in this project.

Combustible strippers are commonly composed of low vapor pressure solvents like n-methyl pyrrolidone (NMP), dibasic esters (DBE) and terpenes or their blends. Generally, in the tests that have been conducted to date, these strippers have also had performance problems. The flammable and combustible strippers can often strip older coating types, like solventborne lacquer coatings and varnishes, fairly well. They are much less effective than the traditional METH-based products on the newer coatings, like cross-linked and water-based paints. As the base of furniture moves more toward the newer coating types, the flammable and combustible products may prove even less effective overall.

In IRTA's earlier project sponsored by NIOSH, three non-METH combustible strippers were tested. One of these was based on terpenes and another was based on DBE. Both of these strippers performed extremely poorly. The third non-METH stripper that was tested contained NMP and, although it did not perform particularly well, it did perform much better than the terpene or DBE strippers. During this project, IRTA decided not to test terpene or DBE formulations.

In order to conduct a good comparative analysis of non-METH alternative strippers, three combustible strippers were tested. The first of these contains NMP as the primary component. The second stripper that was tested contains NMP and a solvent fairly new to the market called Soy Gold. It is classified as a combustible stripper. The third stripper contains Soy Gold and tert-butyl acetate (TBAC). It, too, is classified as a combustible stripper. IRTA decided to test a formulation containing TBAC because the producers of the chemical have petitioned EPA to exempt the chemical from VOC regulations. EPA has proposed but not finalized the exemption. The specific formulations are discussed in more detail below.

### NMP Product

The MSDS for this product, called B23 Industrial Paint Remover, is shown in Appendix B. It consists of 50 to 65% NMP and 15 to 25% aliphatic petroleum distillates. The balance, three different glycol ethers, each account for 5 to 12%. The product has a high VOC content, probably in the range of 8 to 9 pounds per gallon since all of the components are VOCs. The MSDS indicates that the vapor pressure of the stripper is less than 10 mm Hg. The vapor pressure of NMP is less than 1 mm Hg. The vapor pressure of petroleum distillates is about 2 mm Hg. The vapor pressure of the mixture is probably no higher than 2 mm Hg which meets the SCAQMD Rule 1136 cutoff level of 2 mm Hg.

NMP is a reproductive and developmental toxin. Over the last few years, it has been added to EPA's Toxic Release Inventory (TRI) list because of its toxicity. A petition to add the chemical to Proposition 65 is pending. Aliphatic petroleum distillates contains small amounts of aromatic fractions. This means there are probably trace quantities of components like benzene which is an established human carcinogen, toluene which causes central nervous system damage and xylene which can cause birth defects.

NMP, because it is established as a reproductive and developmental toxin, may not meet the requirement that the alternative strippers be less toxic than the baseline stripper. Because the stripper based on NMP was thought likely to be the best alternative non-METH stripper, the project team decided it should be tested for completeness. It was always clear, however, that the toxicity of NMP was an issue of concern.

### NMP/Soy Gold Product

The MSDS for this stripper, called CAE6 Industrial Paint Remover, is included in Appendix C. Soy is a combination of alkyl methyl esters. It is a low vapor pressure material that has a fairly low VOC content, in the range of 90 grams per liter. The company that offers the product promotes its use in paint stripping. The project team decided it was worth testing the soy product in combination with NMP which is the best combustible stripper.

As the MSDS for this product indicates, it contains between 50 and 65% NMP, 15 to 25% of the soy and 15 to 25% of aliphatic petroleum distillates. The vapor pressure is less than 10 mm Hg and it is probably low enough to meet the 2 mm Hg regulatory cutoff limit.

### Soy Gold/TBAC Product

The MSDS for this stripper, called Benco CAE8 Industrial Paint Remover, is provided in Appendix D. It is composed of between 50 and 65% soy or alkyl methyl esters, 15 to 25% TBAC and 5 to 15% methanol.

IRTA wanted to test a stripper containing TBAC. The manufacturer of TBAC has petitioned EPA to exempt TBAC from VOC regulations and the petition is pending. TBAC, however, even if it is exempted, may pose toxicity problems. TBAC itself has not been tested for chronic toxicity so nothing can be concluded about whether or to what extent it may be toxic. The chemical is metabolized in the body to tert-butyl alcohol, however, and tert-butyl alcohol is considered a carcinogen. As is true for the NMP based strippers, stripping formulations based on TBAC may not substantially reduce the toxicity of the current stripper.

If TBAC is exempted from VOC regulations, the VOC content of this stripper would be very low in light of the low VOC content of the other major component, Soy. The vapor pressure of the blend, as indicated on the MSDS, is less than 10 mm Hg and it is likely to be less than 2 mm Hg, the regulatory cutoff level.

### Low-METH Content Strippers

The other category of strippers that were tested during the project contain lower METH concentrations than the baseline B7 stripper. Five low-METH content strippers were tested during this project.

METH/NMP Product. The MSDS for the first product is shown in Appendix E. This stripper, called Benco B25 Industrial Paint Remover, contains between 40 and 50% METH which can be compared with the 80 to 85% in the baseline B7 stripper. The NMP content of the stripper is 20 to 30%. The balance of the stripper is various VOC solvents including glycol ethers and methanol. The stripper, at 291 grams per liter VOC content, meets the 350 grams per liter cutoff level of SCAQMD Rule 1136.

The chemicals in the B25 stripping formulation that have replaced METH in the B7 are all fairly toxic. NMP, as mentioned above, is a reproductive and developmental toxin and 2-butoxy ethanol, a glycol ether, is a listed HAP. METH is an animal carcinogen and it is not clear that replacing the METH with other compounds that have a different toxic endpoint leads to a reduction in toxicity.

METH/TBAC Product. The MSDS for the second low-METH content stripper, called CAE2 Industrial Paint Remover, is shown in Appendix F. This stripper is similar to the METH/NMP stripper described above but the stripper contains TBAC instead of NMP. Again the stripping formulation contains 40 to 50% METH instead of the 80% in the baseline B7 stripper. It also contains 20 to 30% TBAC. As mentioned earlier, TBAC metabolizes to tert-butyl alcohol, a carcinogen. The balance of the stripper is methanol and two glycol ethers.

The stripper is rated at 144 grams per liter VOC content which meets the cutoff level of 350 grams per liter in SCAQMD Rule 1136. The VOC content was determined under the assumption that TBAC will be exempt from VOC regulations.

METH/Soy Gold Product. The MSDS for this product, designated CAE3 Industrial Paint Stripper, is shown in Appendix G. This low-METH product, like B25 and CAE2, contains between 40 and 50% METH. It also contains 20 to 30% alkyl methyl esters or soy. The balance, like B25 and CAE2, is methanol and glycol ethers. This stripper is attractive because the alkyl methyl esters are likely to be very low in toxicity and they have a very low VOC content. The VOC content of the stripper is listed at 142 grams per liter which meets the SCAQMD Rule 1136 requirement.

METH/Propylene Carbonate. The MSDS for this product, deemed CAE4 Industrial Paint Remover, is provided in Appendix H. Like the other low-METH products, this stripper contains between 40 and 50% METH. This particular product contains 20 to 30% 1,3-dioxolan-2-one, methyl which is otherwise known as propylene carbonate. The reason this stripper was formulated is because propylene carbonate has been touted as a good paint stripping agent for several years. Again, similarly to the other low-METH products, this stripper contains methanol and glycol ethers. Propylene carbonate has unknown toxicity. The VOC content of the stripper is 352 grams per liter just slightly above the threshold of 350 grams per liter listed in SCAQMD Rule 1136.

METH/NMP/TBAC/Soy Gold Product. The MSDS for this product, called CAE7, is shown in Appendix I. Like the other low-METH strippers tested in this project, CAE7 contains between 40 and 50% METH. It also contains methanol and between 8 and 15% of NMP, TBAC and Soy Gold. The VOC content is listed at 125 grams per liter which meets the cutoff level for SCAQMD Rule 1136. Again, the toxicity of NMP and TBAC present problems for this formulation.

Table 3-1 summarizes the baseline and eight different strippers that were tested in the project.

**Table 3-1  
Strippers Tested During Project**

Stripper	Ingredients	VOC Content (grams/liter)	Vapor Pressure (mm Hg)
B7 Baseline	METH methanol glycol ethers wetting agents wax	244	< 300
B23B	NMP aliphatic petroleum distillates glycol ethers	-	< 10
CAE6	NMP aliphatic petroleum distillates soy	672	< 10
CAE8	Soy TBAC methanol surfactants	79a	< 10
B25	METH NMP methanol glycol ethers surfactants wax	291	< 300
CAE2	METH TBAC methanol glycol ethers surfactants wax	144a	< 300
CAE3	METH soy methanol glycol ethers surfactants wax	142	< 300
CAE4	METH propylene carbonate methanol glycol ethers surfactants wax	352	< 300
CAE7	METH NMP TBAC soy methanol surfactants wax	125a	< 300

a Assumes TBAC is exempt from VOC regulations with a VOC content of zero grams per liter

Note that the low-METH strippers in Table 3-1--B25, CAE2, CAE3, CAE4 and CAE7--all have parallel constructions. That is, they all contain METH at the same percentage. Four of them--B25, CAE2, CAE3 and CAE4--contain one additional active ingredient as well as methanol, glycol ethers, surfactants and wax. In addition to METH, CAE7 contains three active ingredients (NMP, soy and TBAC) instead of the glycol ethers and also contains methanol, surfactants and wax.

#### ALTERNATIVE STRIPPER TESTS

Two facilities in the South Coast Basin were selected for the extensive comparative tests of the baseline and eight alternative strippers listed in Table 3-1. The owners agreed to assist the project team in carrying out the tests of alternative strippers. The test facilities include:

- Strip Joint  
136 No. Catalina Ave.  
Redondo Beach, CA 90277
- Sunset Strip  
17381 Nichols St. #F  
Huntington Beach, CA 92647

Each of these facilities has both a dip tank and a flow tray. Both also have a rinse booth. The Strip Joint personnel strip furniture three days a week, 8 hours per day. Sunset Strip generally strips a few days each week for several hours. The two facilities are busy shops and fall into the category of larger strippers.

The nine strippers that were tested at Strip Joint include:

- B7 baseline stripper
- B23B
- CAE6
- CAE8
- B25
- CAE2
- CAE3
- CAE4
- CAE7

Out of the eight alternatives, three performed well at Strip Joint. Only the baseline stripper and the three best low-METH alternative strippers were tested at Sunset Strip.

Benco Sales, the firm that provides stripping formulations and equipment to most of the Southern California furniture strippers, donated the B7 baseline stripper for the tests. The company also sells B23B stripper to a few strippers in the country. Benco Sales also specially formulated the seven additional alternative strippers for this project.

The tests of the baseline and alternative strippers were conducted during a two-day session at Strip Joint and a one-day session at Sunset Strip. The facilities each collected items with different types of coatings in advance of the scheduled stripping sessions. In particular, they tried, to the extent possible, to select matched items that could be used for comparison of the strippers. Examples of matched items include bureaus with several drawers and sets of several identical chairs.

Tests of the two best alternative strippers and the baseline stripper were conducted at two additional stripping facilities to select the alternative stripper that performed best. The two additional facilities are:

- Los Angeles Stripping & Finishing Center  
1120 N. San Fernando Rd.  
Los Angeles, CA 90065
- Stripper Herk  
2015 1/2 Main Street  
Santa Monica, CA 90405

#### Criteria for Stripping Formulations

Four performance criteria were selected for determining the ability of the strippers to strip the wide variety of the coatings encountered by furniture strippers. Another criterion that was thought to be important, since these facilities are virtually always small businesses, is the cost of the alternative stripper. The five criteria that were compared are:

- stripping time
- ease of removal
- removal quality
- usage based on volume/coverage area
- cost

During the preparation for the stripper testing, the project team agreed that it would be best to fix the stripping time for each of the strippers. As discussed in more detail below, this decision was made because it was anticipated that some of the stripping formulations might not be especially effective. If the stripping time was to be determined, the stripping formulation tests might have had to last for weeks. With the time fixed, the other variables could be measured quantitatively or qualitatively.

Ease of removal is a characteristic that must be judged qualitatively by the worker performing the stripping. If the stripper completely stripped the coating, then there appeared to be no difference between the strippers in the removal quality. In cases where the stripper did not completely strip the coating, the removal quality was obviously not as good.

The time allotted for stripping with each of the strippers was set at between 40 and 45 minutes. The worker stripped various items which were part of matched pairs for this period. After each item was stripped, the worker used the water wash booth to rinse each piece. Finally, the worker placed the items in the drying area.

At each of the two major test facilities, furniture pieces made of a variety of woods were stripped. These included ash, oak, pine, walnut, mahogany, teak and poplar. The coating types were also varied and included lacquer, varnish and pigmented coating. The worker qualitatively evaluated the ease of removal of the coating and, if all of the coating was removed, the removal quality was judged to be good.

The stripper usage was logged for each of the stripping formulations by weighing the stripper container before and after stripping. The cost was estimated only for the best performing alternative strippers.



The stripping tests were recorded in photographs. In what follows, the photographs are included and their content is discussed.

#### Photographs From Initial Screening Stripper Tests at Strip Joint

Figure 3-1 shows an example of two cabinet doors that were stripped at the Strip Joint. Figure 3-2 shows an example of a chair that was stripped during the stripping tests.

Figure 3-3 shows an example of a drawer with a difficult to remove pigmented coating and Figure 3-4 shows an example of another drawer.

Figures 3-5 and 3-6 show the worker applying the B7 baseline stripper to cabinet doors in the flow tray. Figure 3-7 shows a view of the worker rinsing one of the stripped items in the water wash booth.

Figures 3-8 through 3-13 show the quality of several items that are drying after being stripped with the B7 baseline stripper. They include two sets of drawers, two chairs and two cabinet doors. Note that the coatings are completely removed from the items.

Figures 3-14 through 3-19 show the furniture that was stripped with the B23B stripper which contains NMP and DBE but no METH. The stripped items include two drawers, two chairs and two cabinet doors. The coatings have been removed adequately from the chairs because they contain lacquers. The drawers, however, particularly the one shown in Figure 3-14 which had a pigmented coating, still contain portions of the coating. The paint has not been completely stripped from one of the cabinet doors shown in Figure 3-19.

Figures 3-20 through 3-25 show the furniture that was stripped with the CAE6 stripping formulation which contains NMP and soy gold but no METH. Again, this non-METH stripper had difficulty in removing all of the coatings. The coatings on the drawers in particular were not fully removed. In Figure 3-20, for example, the pigmented coating on the drawer is still largely intact. The stripper even had difficulty in removing the lacquer stain on the cabinet doors as shown in Figure 3-24.

Figures 3-26 through 3-30 show the furniture items that were stripped with the CAE8 stripping formulation. This formulation contains soy gold and TBAC but does not contain METH. Like B23B and CAE6, the other non-METH strippers, CAE8 performed very poorly. The stripper could not remove the stain from the drawer in Figure 3-26 or the pigmented coating from the drawer in Figure 3-27. The formulation also could not effectively remove the coatings from the cabinet doors shown in Figure 3-29 and 3-30.

Figures 3-31 through 3-36 show the furniture stripped with B25, the low-METH stripper that contains NMP. This coating stripped all of the furniture items well. It was very effective in removing even the pigmented coating from the drawer shown in Figure 3-32. It removed the coatings well from the chair base and the chair shown in Figures 3-33 and 3-34 respectively. It also removed the cabinet door coatings as shown in Figures 3-35 and 3-36.

Figures 3-37 through 3-42 show the furniture items stripped with CAE2, the low-METH stripping formulation that also contains TBAC. All items were stripped effectively including the pigmented coating on the drawer shown in Figure 3-38.

Figures 3-43 through 3-48 show the items stripped with CAE3, the low-METH formulation containing soy. This stripper did not perform as well as the other two low-

METH strippers, B25 and CAE2. It also separated into two distinct components during the stripping and became less effective as time passed.

Figures 3-49 through 3-54 show the items stripped with CAE4, the low-METH stripping formulation containing propylene carbonate. This stripper did not work as well as the other low-METH strippers, B25 and CAE2. It was not able to remove the pigmented coating from the drawer in Figure 3-50.

Figures 3-55 through 3-60 show the furniture that was stripped with CAE7, the low-METH stripper that contains NMP, soy and TBAC. This stripper did not perform as well as two of the other low-METH strippers, B25 and CAE2. It was not capable of stripping the pigmented coating from the drawer shown in Figure 3-56. It also left some residue of the stain on the chair support shown in Figure 3-58.

Figure 3-61 shows the stripped furniture piled in the drying area in groups for each stripper. The appearance of this furniture was used to judge the stripping ability of each of the strippers.

#### Comparison of Alternative Strippers at Strip Joint

In many cases, it is difficult to determine a visual difference in the strippers from the photographs. For one thing, the lighting and angle make a difference. Another issue is that several of the strippers stripped some of the items which contain an easily stripped lacquer coating fairly well.

The stripping time for the tests was fixed. The worker stripped similar pieces of furniture with each stripper. The worker that performed the stripping at the Strip Joint gave his opinion of the strippers. He liked B7, the baseline stripper, the best. The non-METH strippers performed very poorly and were not capable of stripping the coatings uniformly; the worker thought they were completely unacceptable. Next to the B7, the worker thought the B25 stripper, the low-METH stripper that contained NMP, worked best. The next best stripper, in his view, was CAE2, the Low-METH stripper containing TBAC. He believed the other low-METH strippers were completely unacceptable because of poor performance.

#### Photographs from Sunset Strip

At Sunset Strip, the strippers that performed best at Strip Joint were tested further. The strippers that performed best at Strip Joint were B7, the baseline METH stripper, B25, the low-METH stripper containing NMP and CAE2, the low-METH stripper containing TBAC. The project team also decided to further test CAE3, the low-METH stripper containing soy. Figures 3-62 and 3-63 show the flow tray during stripping for the alternative stripper comparison at Sunset Strip. Figure 3-64 shows the water wash booth used in the stripper tests.

Figures 3-65 through 3-70 show several items that were stripped with the baseline and two alternative stripping formulations at Sunset Strip. Figure 3-65 shows a large mahogany headboard containing lacquer before stripping. Figure 3-66 shows a mahogany drawer containing a lacquer finish. Figure 3-67 shows a boat step made of teak with a varnish finish. Figure 3-68 shows a poplar drawer containing lacquer. Figure 3-69 shows a poplar door containing lacquer. Figure 3-70 shows a mahogany drawer containing a lacquer.

Figures 3-71 and 3-72 show several furniture items that were stripped with the B7 stripper. These items are drying. Note that the stripper removed all of the coatings effectively.

Figures 3-73 through 3-76 show the furniture items after they were stripped with B25, the low-METH NMP stripper. The stripper was very effective on all the pieces except the boat step. This piece even presented some problem for the B7 baseline stripper.

Figures 3-77 and 3-78 show the furniture after it was stripped with CAE2, the low-METH stripper containing TBAC. This stripper, like the B25 performed fairly well. Again, the boat step was the piece most difficult to strip.

Figures 3-79 and 3-80 show the furniture after stripping with CAE3, the low-METH stripper containing soy. This stripper did not perform as well as the B25 or the CAE2. It did not effectively remove all of the coatings and the formulation separated into two phases in the supply container.

#### Comparison of Alternative Strippers at Sunset Strip

The worker at Sunset Strip judged that the B7 baseline stripper performed the best but that two alternative strippers also performed very well. The other two strippers that performed well were the B25 low-METH stripper containing NMP and the CAE2 low-METH stripper containing TBAC. He believed that the two alternative strippers performed equally well.

#### ADDITIONAL LONGER-TERM ALTERNATIVE STRIPPER TESTS

The ventilation system testing is described in the next chapter. The intent was to select the best performing alternative stripper and compare the results of the source tests with this alternative stripper to the results with the baseline stripper. Two of the alternative strippers appeared to perform well so additional testing was conducted with four facilities to determine which one should be used during the ventilation system testing.

Another aim in selecting the best alternative stripper was to determine which one would perform best over the longer term. Some of the low-METH strippers tested in other projects did not perform well over the longer term. The METH, because of its high vapor pressure, evaporated rapidly leaving the stripper ineffective with a substantial volume remaining. Although METH could have been added to the stripper to restore its performance, this would defeat the purpose of using a low-METH stripper in the first place. Thus, one of the criteria for selecting the best alternative stripper was that the stripper retain its composition over the longer term. Accordingly, IRTA provided both B25, the NMP stripper and CAE2, the TBAC stripper to four facilities for longer term testing. These facilities were the Strip Joint, Sunset Strip, Stripper Herk and Los Angeles Stripping & Finishing Center.

#### Results of the Longer Term Stripper Tests

The worker at Sunset Strip used the two alternative strippers periodically over a month to determine if they were effective. Both B25 and CAE2 retained a constant composition. The worker did not like either of the alternative strippers as well as B7. If forced to select an alternative stripping formulation, he indicated that the B25 had a slight edge in performance over the CAE2.

At Stripper Herk, the workers also tested the two alternative strippers over a one-month period. They tested furniture with various types of coatings including lacquer and pigmented coatings with the two strippers. Stripper Herk has two flow trays and the two alternative strippers were each tested in one tray at the same time that B7, the baseline stripper, was tested in the second tray. Figure 3-81 shows a worker stripping cabinet doors in one of the flow trays during the testing. Figure 3-82 shows one of the cabinet doors during the stripping. Figure 3-83 shows some the furniture drying after stripping and rinsing. The workers at Stripper Herk indicated that they liked the B7 baseline stripper the best. They also stated that they liked the CAE2 TBAC stripper better than the B25 NMP stripper overall. The testing indicated that the CAE2 stripper performed better with lacquer coatings whereas the B25 performed better with pigmented coatings. Although the workers liked the CAE2 better than the B25, they did not like the odor of the CAE2. Another problem was that the workers thought the CAE2 did not rinse well. The CAE2 retained its effectiveness longer than the B25.

At Los Angeles Stripping & Finishing Center, the workers also noted the intense smell of the CAE2. They indicated that the B25 stripped much faster when it was fresh; it did not retain its effectiveness over time. The B25 rinsed better than the CAE2. The CAE2 penetrated and stripped more slowly than the B25. The B25 worked well on a lacquer coating on cabinet doors but neither stripper worked especially well on the pigmented coatings on carousel horses the facility stripped. It's worth noting that even the B7 does not easily strip the coatings on the carousel horses. Figures 3-84 and 3-85 show two views of the owner of the stripping facility stripping a carousel horse in the flow tray during the testing.

Sunset Strip tested the alternative strippers extensively on a variety of coatings including varnish, lacquer and shellac. On most coatings, the owner of the facility found that CAE2 and B25 stripped and rinsed about the same as the baseline stripper, B7. The owner indicated that the smell of the CAE2 might be an issue. He also indicated that the B25 took a very long time to dry which could pose a problem for subsequent refinishing. In some cases, the owner found that the CAE2 became ineffective more quickly than the B25.

IRTA conducted additional testing on stripper usage at Sunset Strip in order to obtain some information on the comparative cost of using the B7 and the alternative strippers. The intent was to strip panels containing the same coatings to get a rough idea of the volume of stripper required.

Two panels were stripped with the B7 baseline stripper and the CAE2 alternative stripper containing TBAC. Four panels were stripped with the B25 alternative stripper containing NMP. The volume of stripper used was recorded during the testing. IRTA then calculated the volume of stripper lost per square foot of panel stripped.

For B7, the value was 0.208 gallons per square foot. For CAE2 and B25, the values were much lower, 0.078 gallons per square foot and 0.059 gallons per square foot respectively. It was expected that the volume used would be lower for the alternative strippers since their vapor pressure is much lower than the vapor pressure of the B7. The values obtained during this test are used later to perform a cost analysis of the alternative strippers.

#### ALTERNATIVE STRIPPING FORMULATION RANKING

The data from the testing suggested a ranking for the alternative strippers. Not surprisingly, the B7 baseline stripper performed best of all the strippers tested. The next

best performing strippers were the B25 low-METH stripper containing NMP and the CAE2 low-METH stripper containing TBAC. The three other low-METH strippers, CAE3, CAE4 and CAE7, did not perform very well for a variety of reasons. The non-METH strippers were virtually ineffective on many of the coatings. In summary, then, the ranking for the strippers tested in this project is as follows:

- B7 baseline stripper
- B25 and CAE2 low-METH strippers
- CAE3, CAE4 and CAE7 low-METH strippers
- B23, CAE6 and CAE8 non-METH strippers

The next phase of the project was to test both B7, the baseline stripper, and the best alternative stripper with the higher air flow ventilation systems. The B25 and the CAE2 were the next best performing strippers and one of these had to be selected for the ventilation system testing. Although each of the alternatives had advantages and disadvantages from a technical standpoint, after consultation with CARB staff, a decision was made to test the B25 NMP stripper during the ventilation system investigation. The B25 stripper had demonstrated a lower consumption rate than the CAE2 stripper during the long-term stripping tests. Because a lower consumption would lower exposure and cost, the B25 was the alternative stripper selected for the ventilation system testing.

Figure 3-1. Cabinet Doors Stripped at Strip Joint

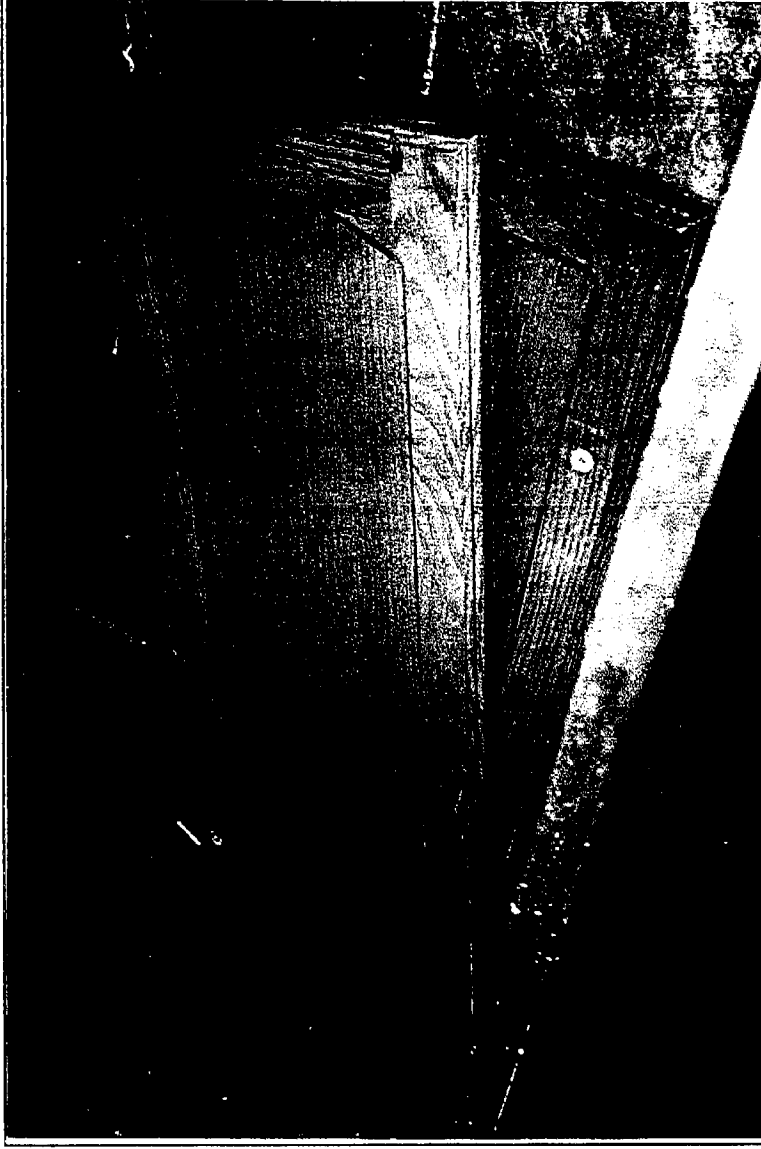


Figure 3-2: Chair Stripped at Strip Joint



Figure 3-3: Drawer with Pigmented  
Coating Stripped at Strip Joint

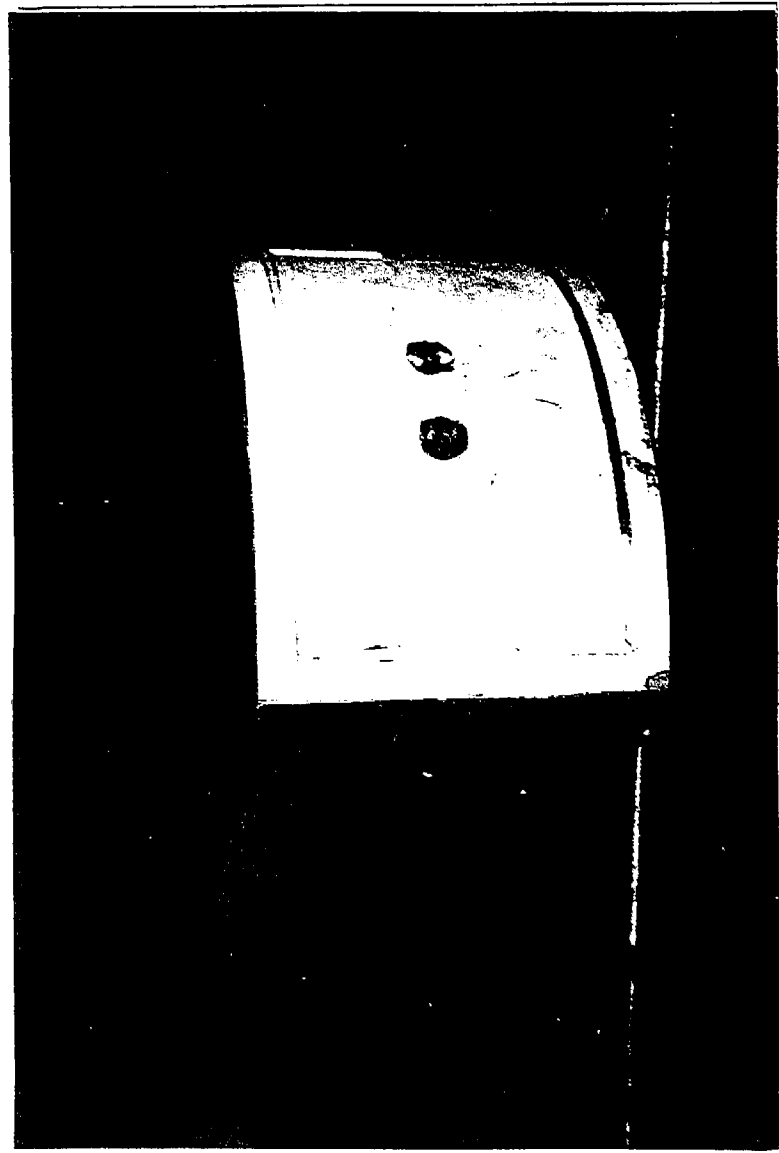


Figure 3-4: Drawer Stripped at  
Strip Joint



Figure 3-5: Worker Applying B7 Stripper at Strip Joint

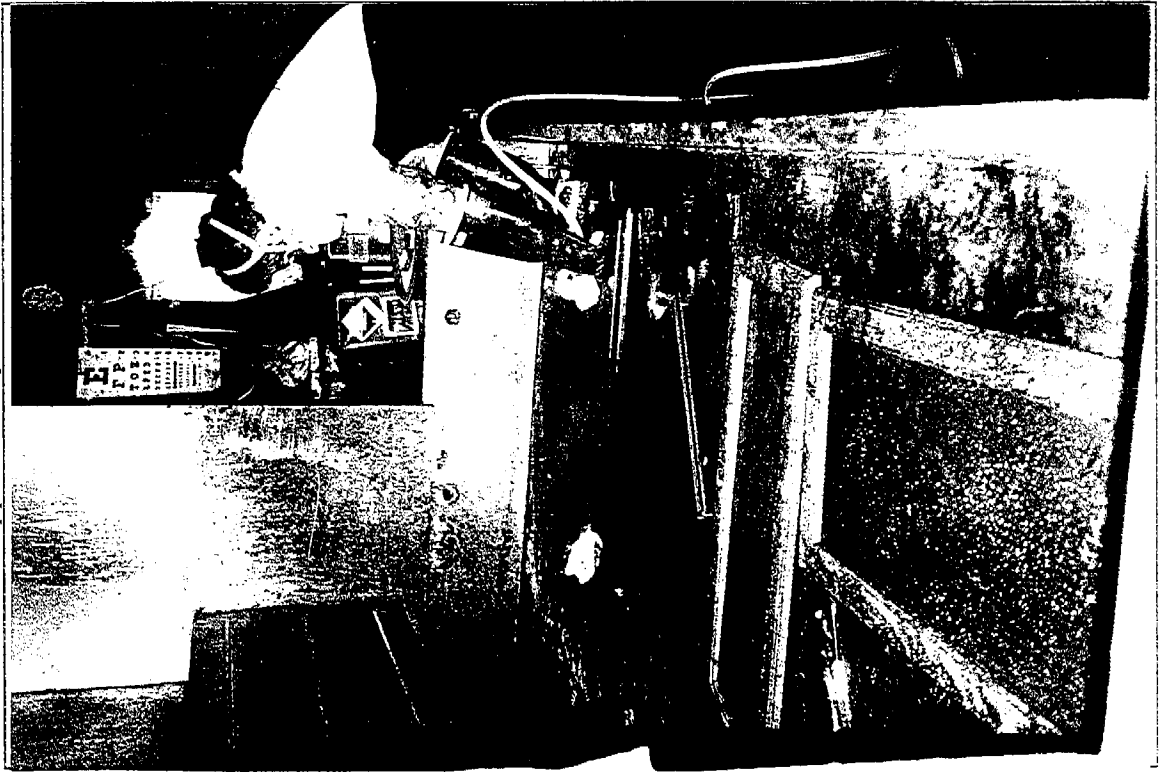


Figure 3-6: Another View of Worker Applying B7 Stripper at Strip Joint





Figure 3-7: Worker Rinsing Chair at Strip Joint



Figure 3-8: Drawer Stripped with B7 Stripper at Strip Joint

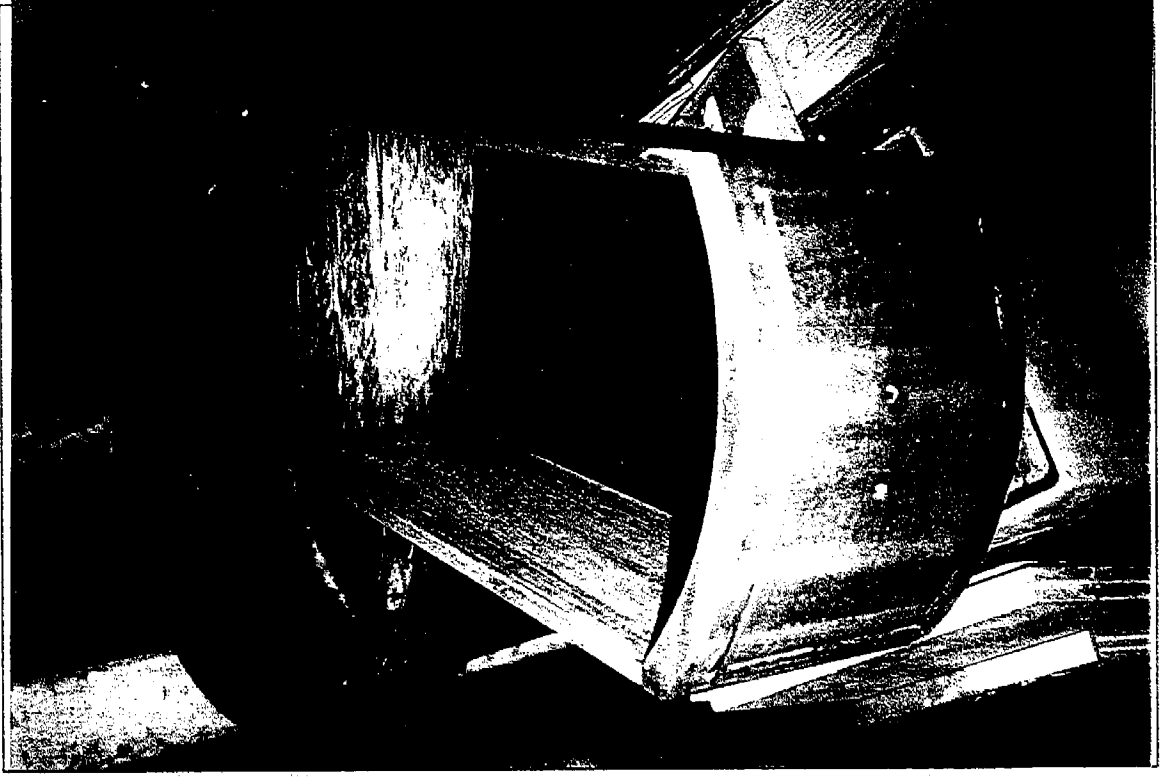


Figure 3-9: Drawer Stripped with B7 Stripper at Strip Joint

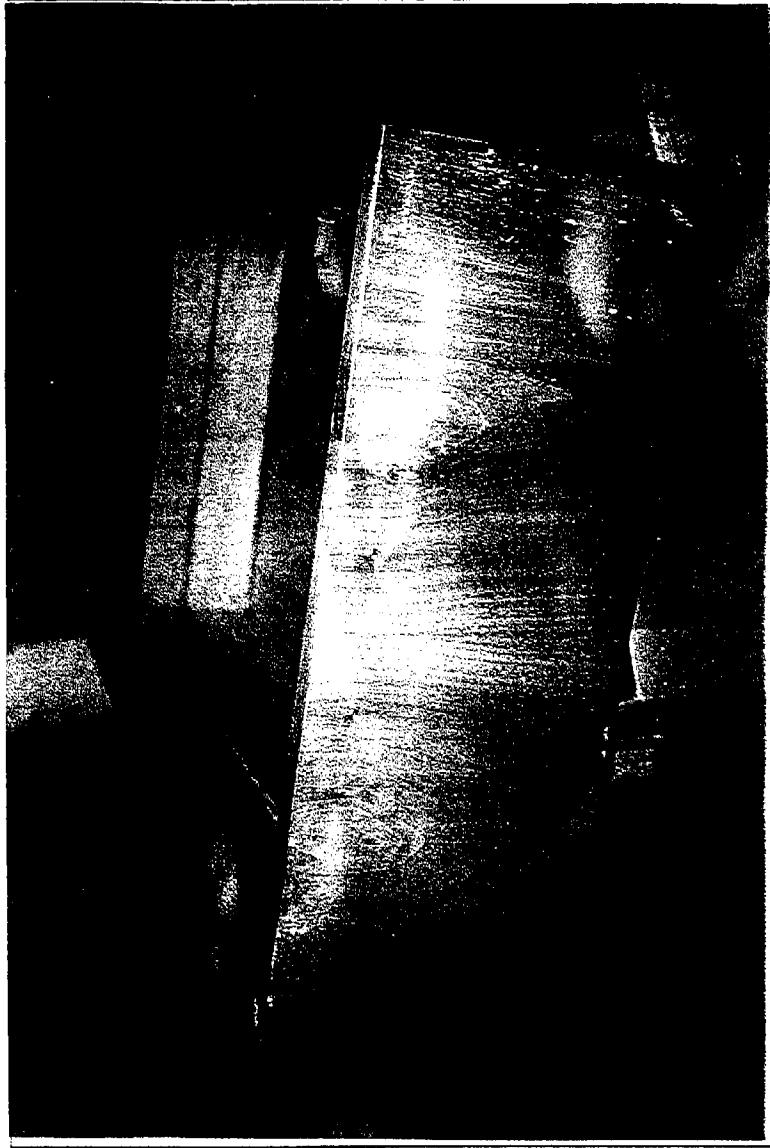


Figure 3-10: Chair Stripped with B7 Stripper at Strip Joint

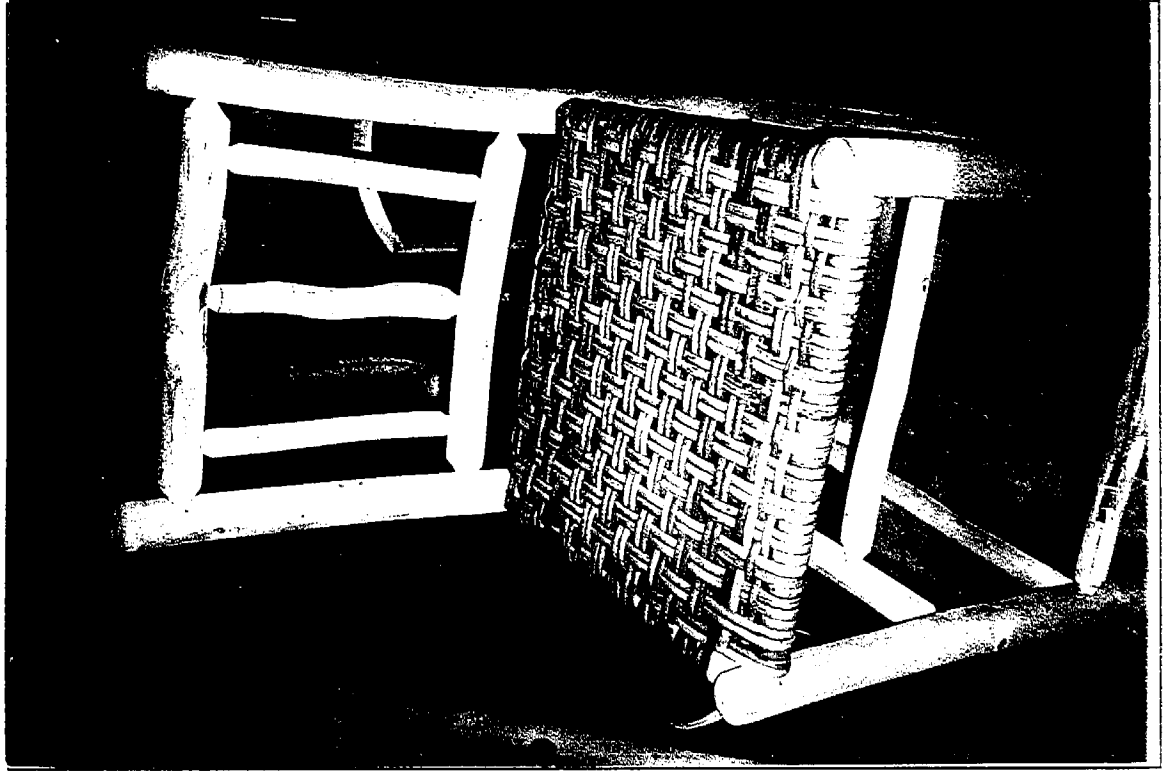


Figure 3-11: Chair Stripped with B7  
Stripper at Strip Joint

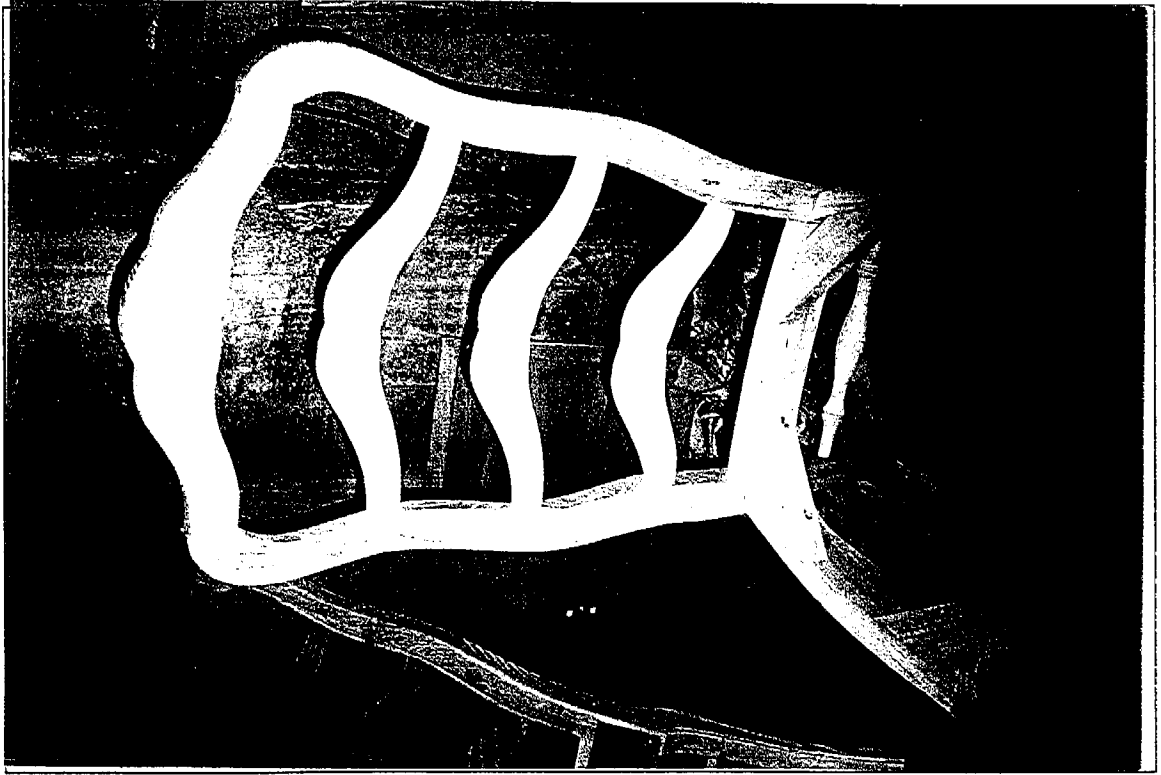


Figure 3-12: Cabinet Doors Stripped  
with B7 Stripper at Strip Joint



Figure 3-13: Drawer Stripped with B7  
Stripper at Strip Joint

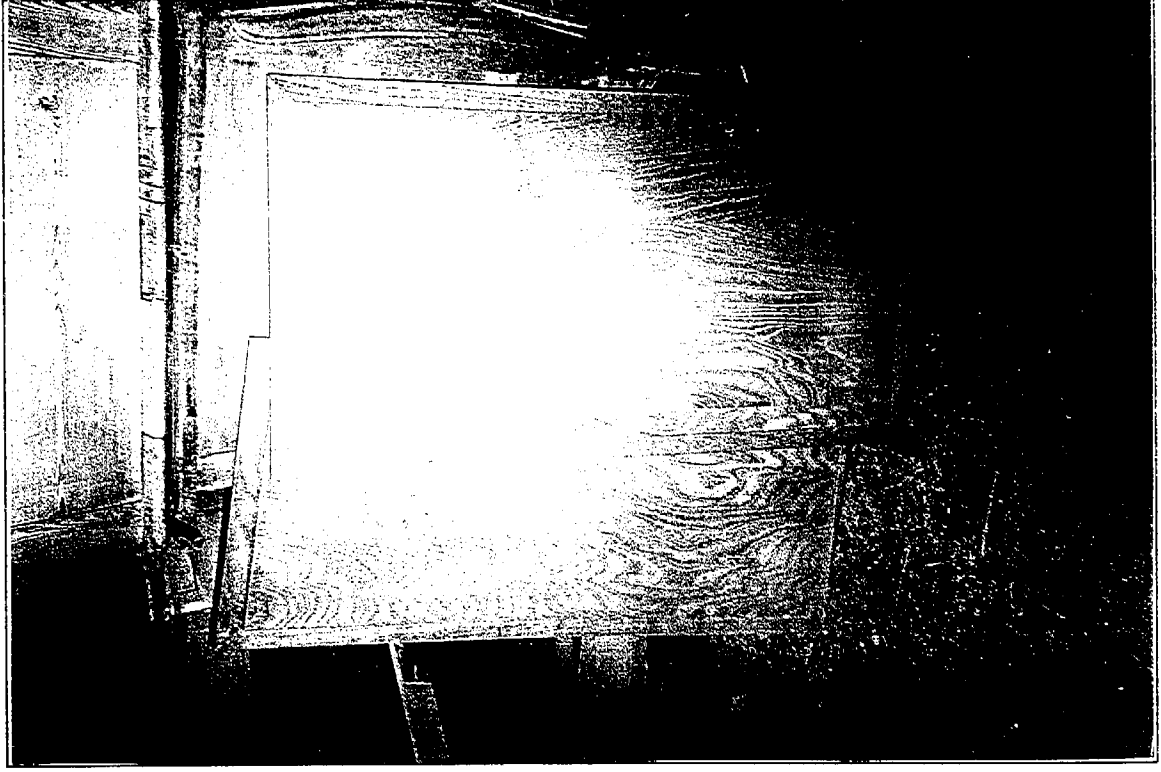


Figure 3-14: Drawer Stripped with B23B  
Stripper at Strip Joint

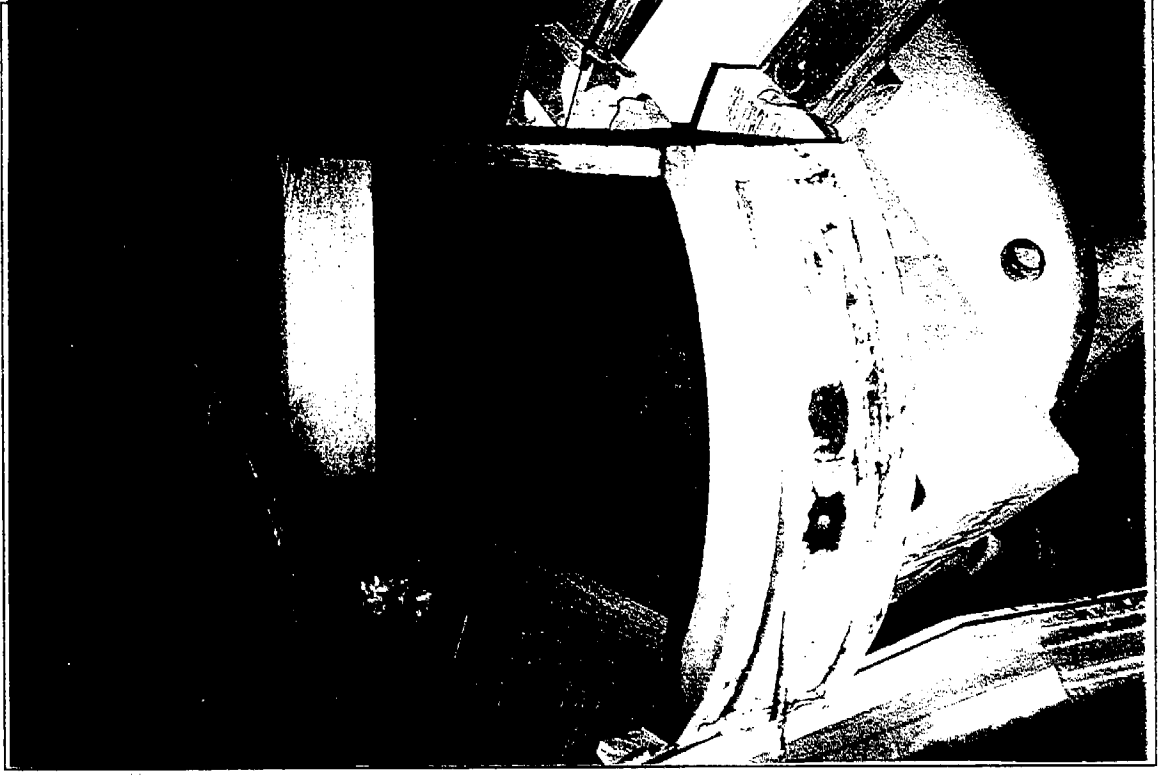


Figure 3-15: Drawer Stripped with B23B Stripper at Strip Joint

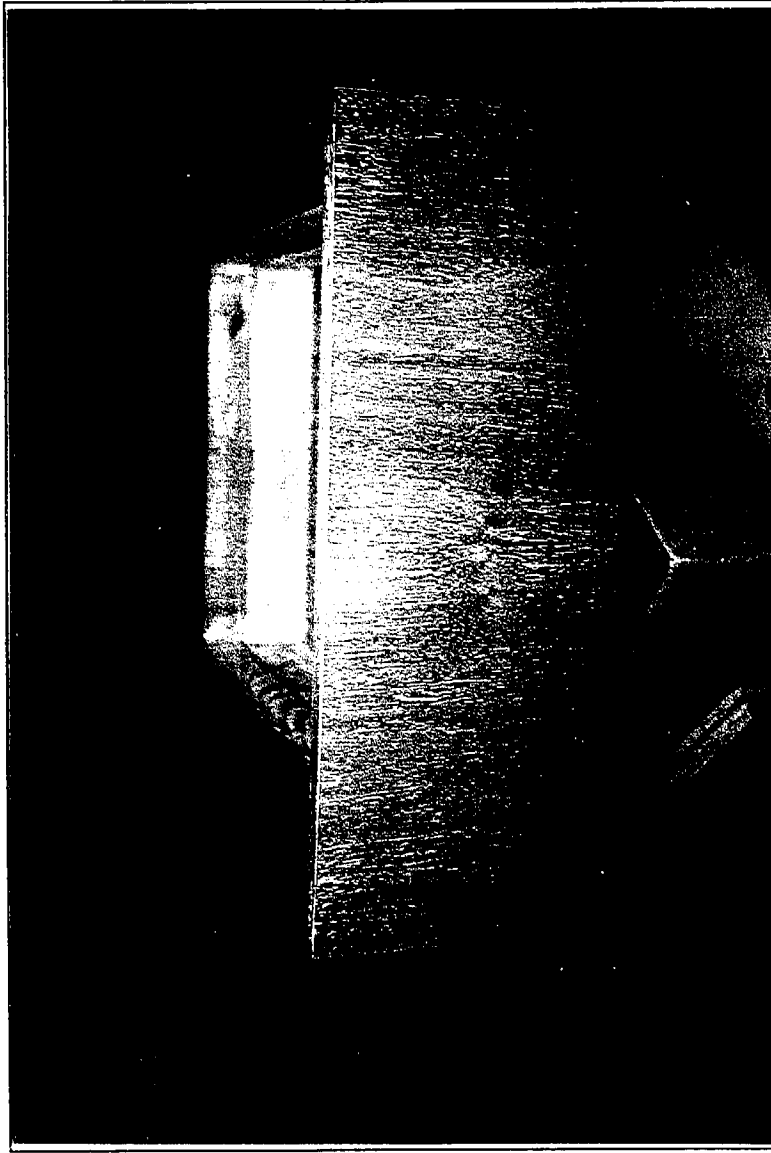


Figure 3-16: Chair Stripped with B23B Stripper at Strip Joint



Figure 3-17: Chair Stripped with B23B Stripper at Strip Joint



Figure 3-18: Door Stripped with B23B Stripper at Strip Joint

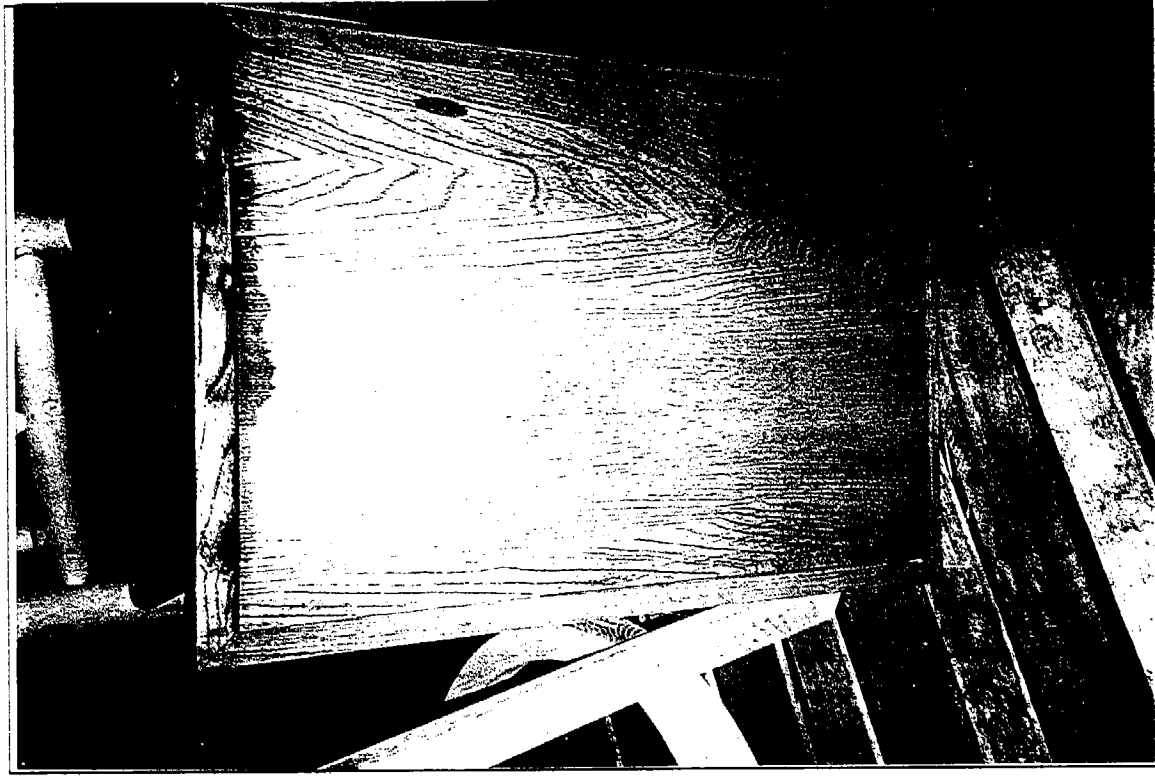


Figure 3-19: Door Stripped with B23B  
Stripper at Strip Joint

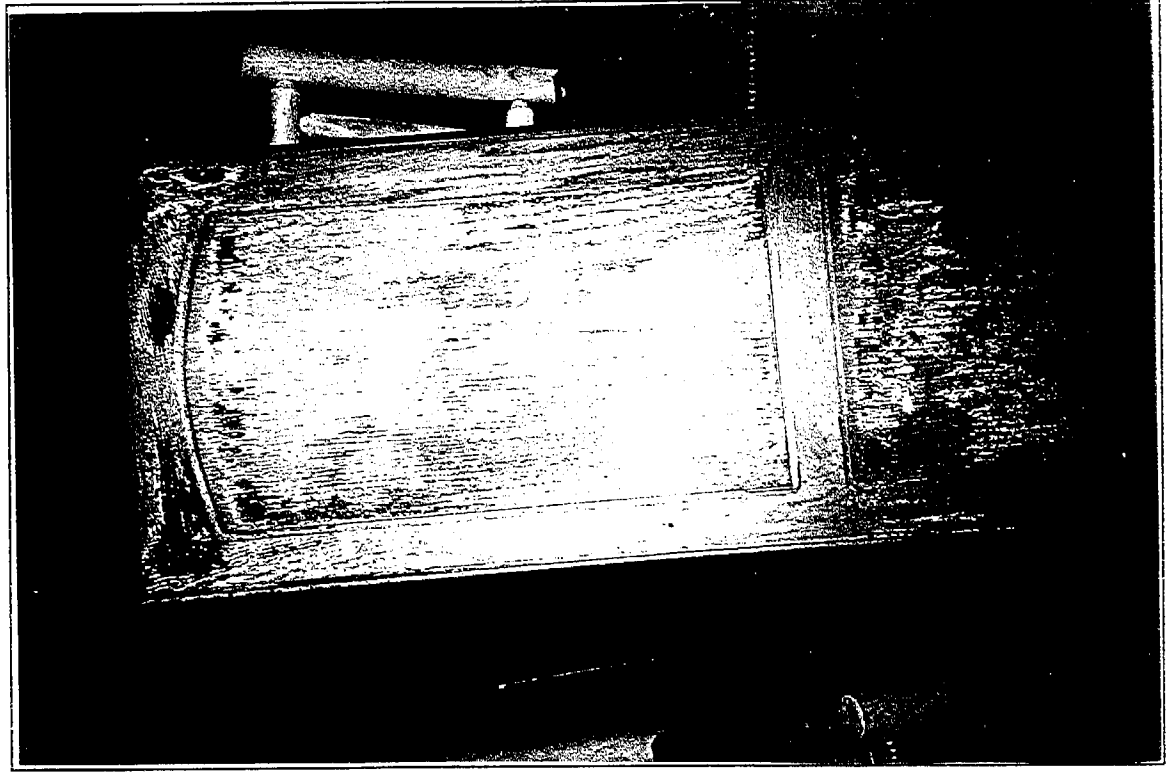


Figure 3-20: Drawer Stripped with CAE6  
Stripper at Strip Joint

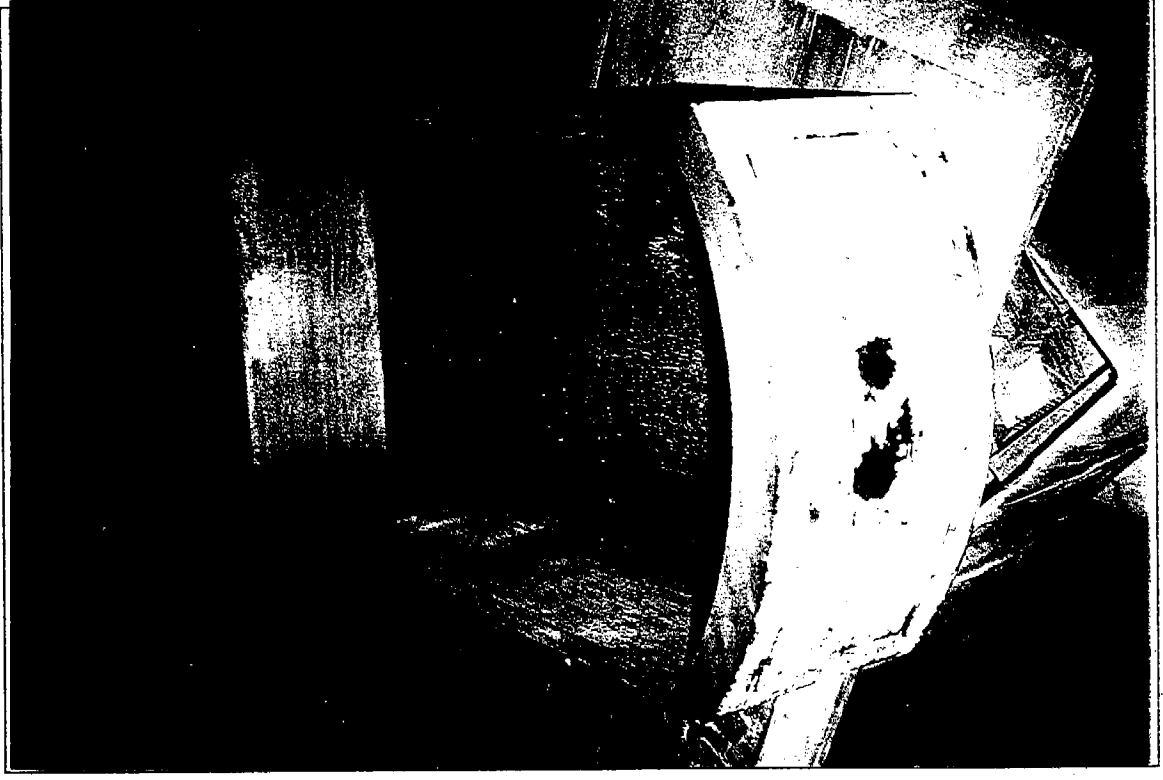


Figure 3-21: Drawer Stripped with CAE6  
Stripper at Strip Joint

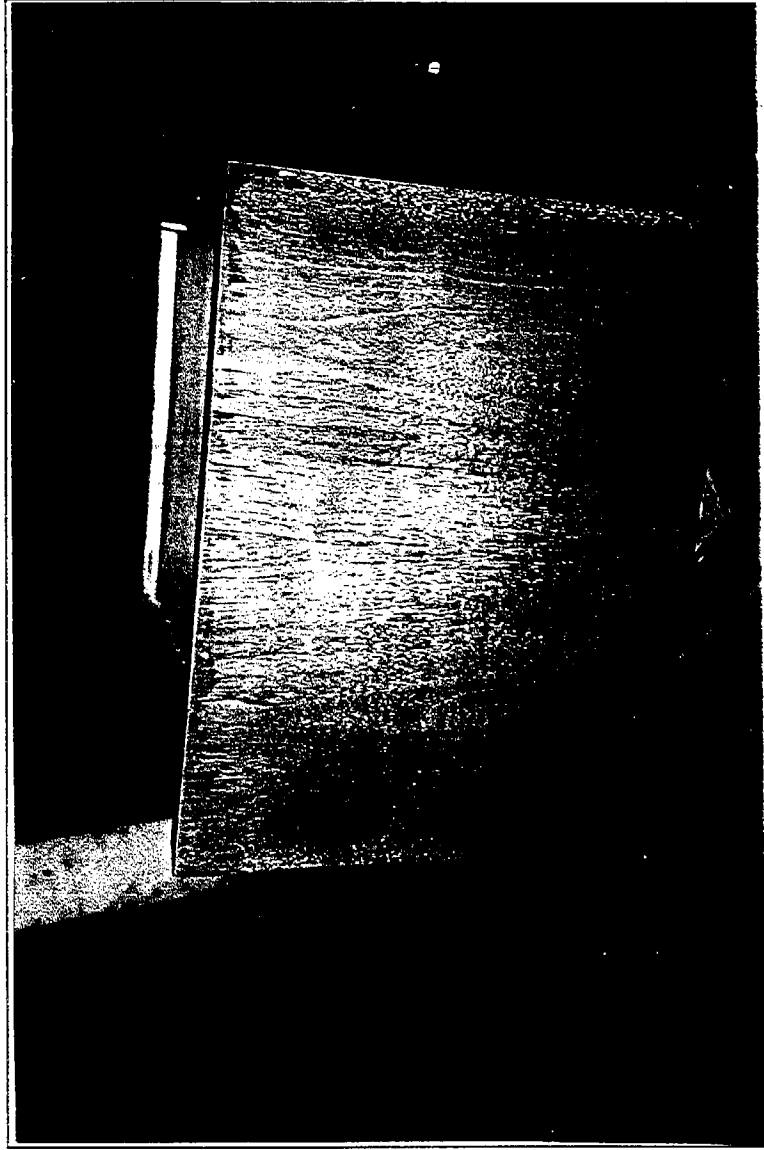


Figure 3-22: Chair Stripped with CAE6  
Stripper at Strip Joint

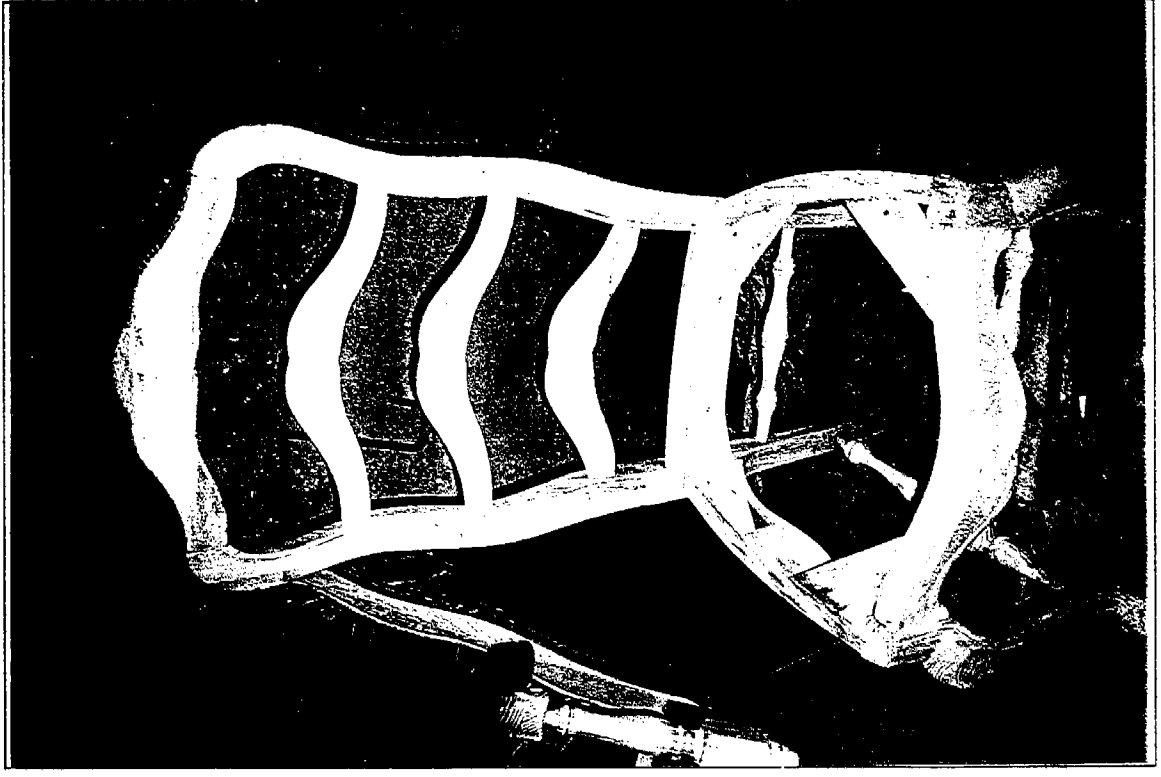




Figure 3-23: Chair Stripped with CAE6  
Stripper at Strip Joint

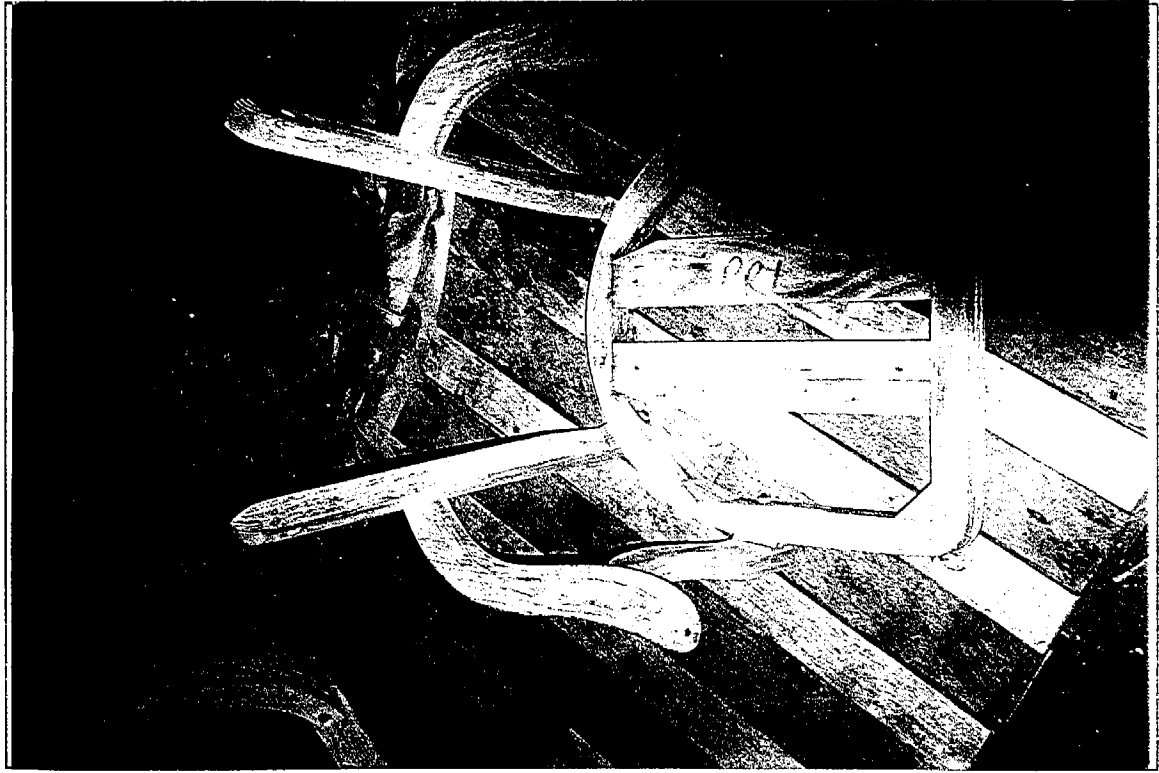


Figure 3-24: Door Stripped with CAE6  
Stripper at Strip Joint

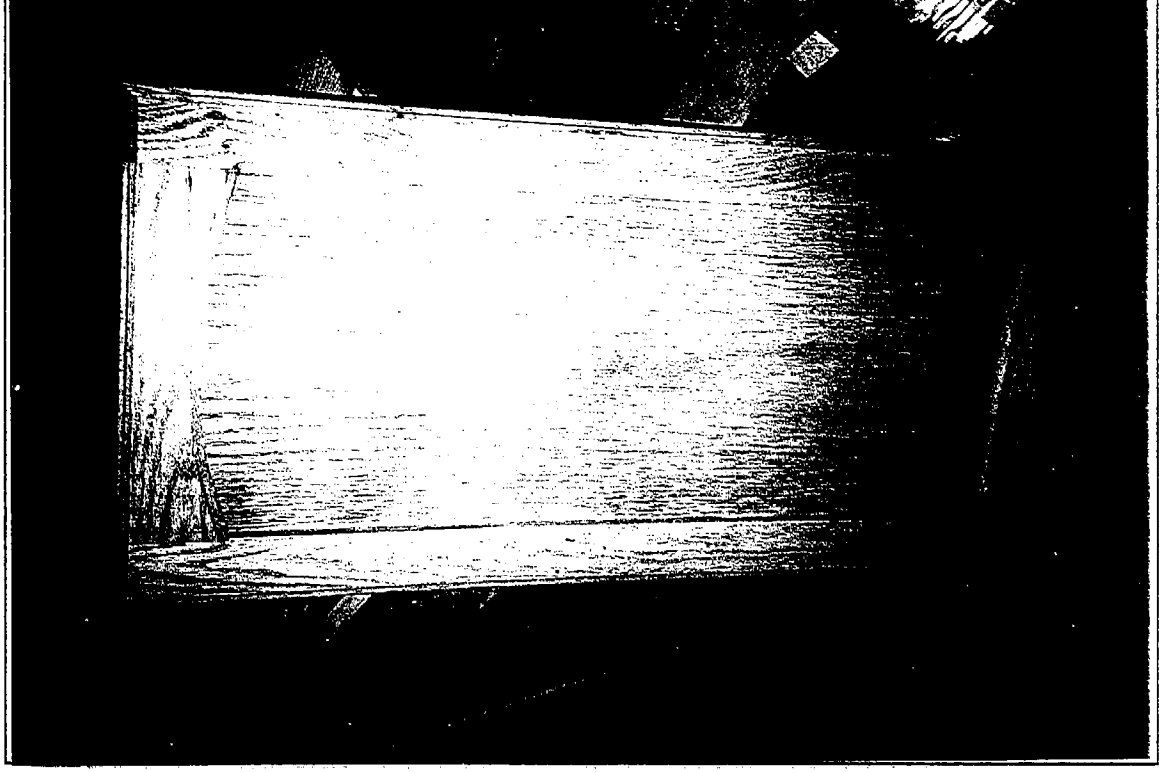


Figure 3-25: Door Stripped with CAE6  
Stripper at Strip Joint

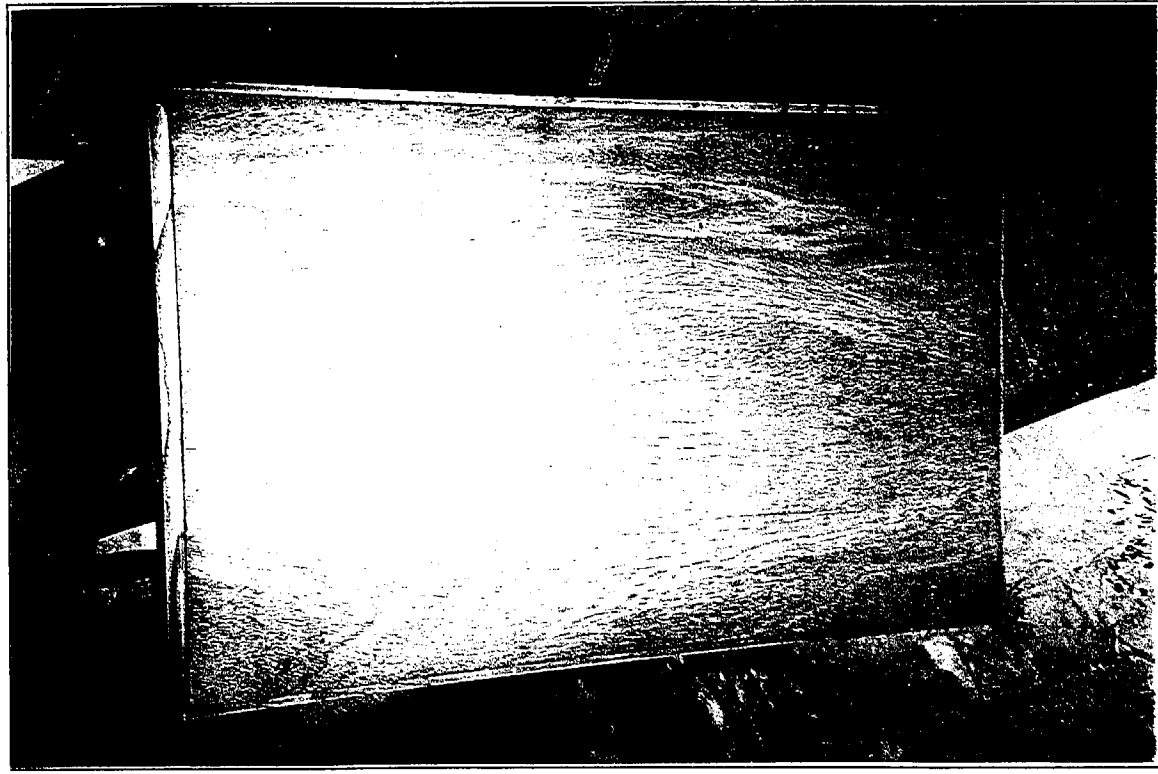


Figure 3-26: Drawer Stripped with CAE8 Stripper at Strip Joint



Figure 3-27: Drawer Stripped with CAE8  
Stripper at Strip Joint

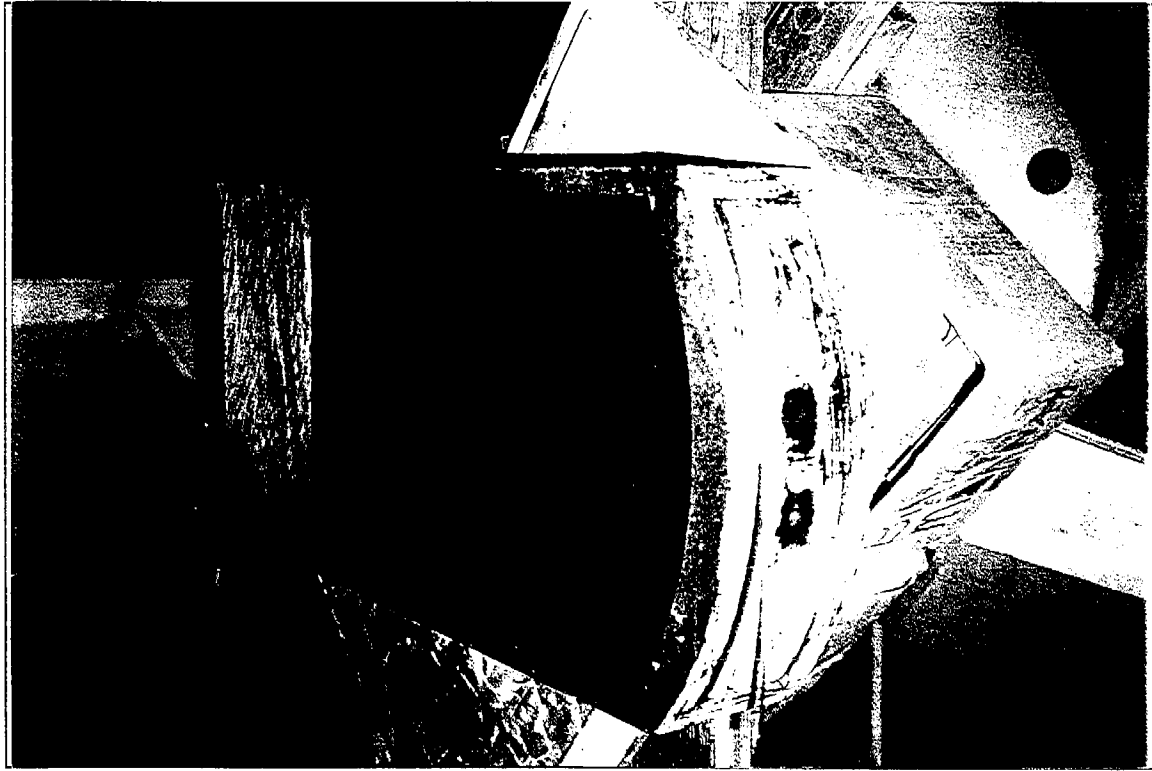


Figure 3-28: Table Leg Stripped with CAE8 Stripper at Strip Joint

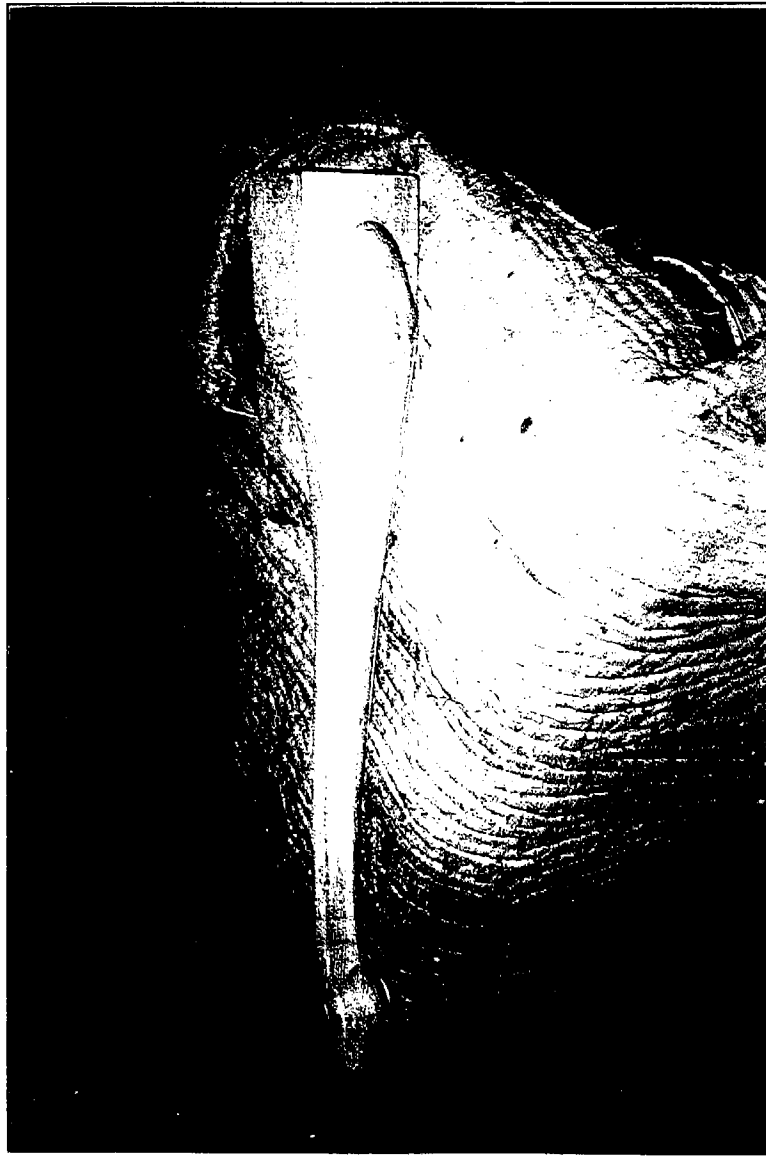


Figure 3-29: Door Stripped with CAE8  
Stripper at Strip Joint

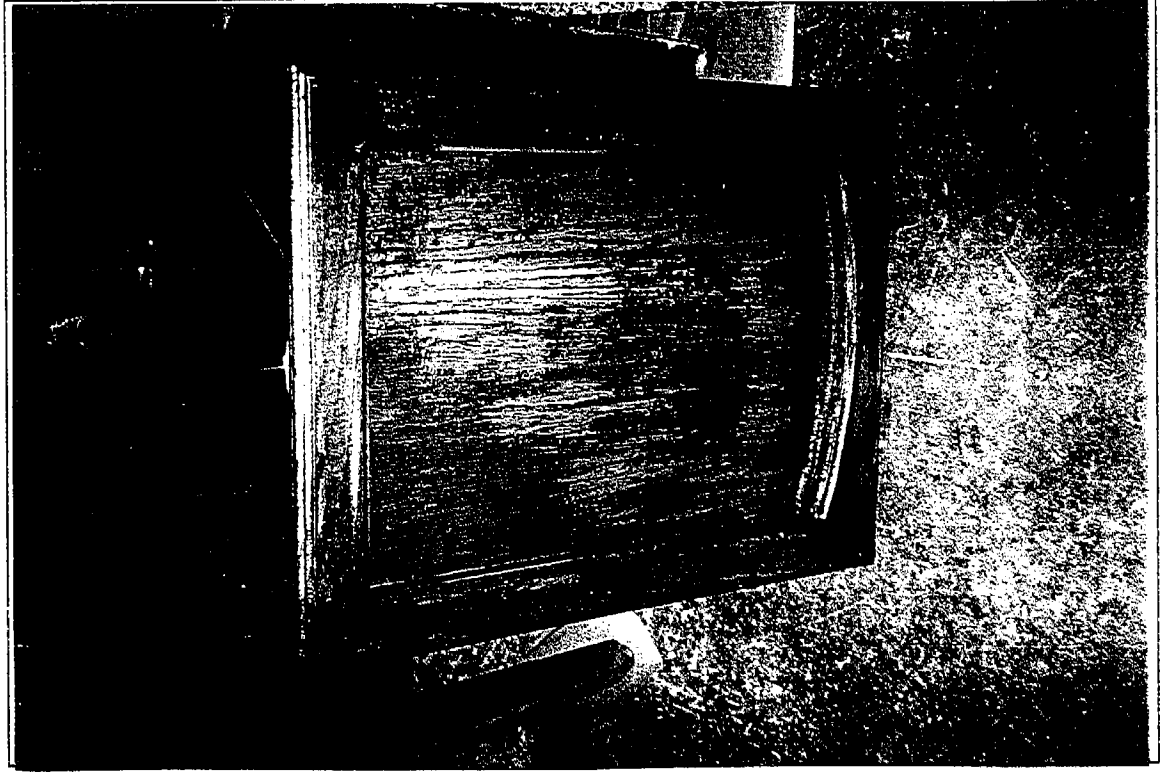


Figure 3-30: Door Stripped with CAE8  
Stripper at Strip Joint

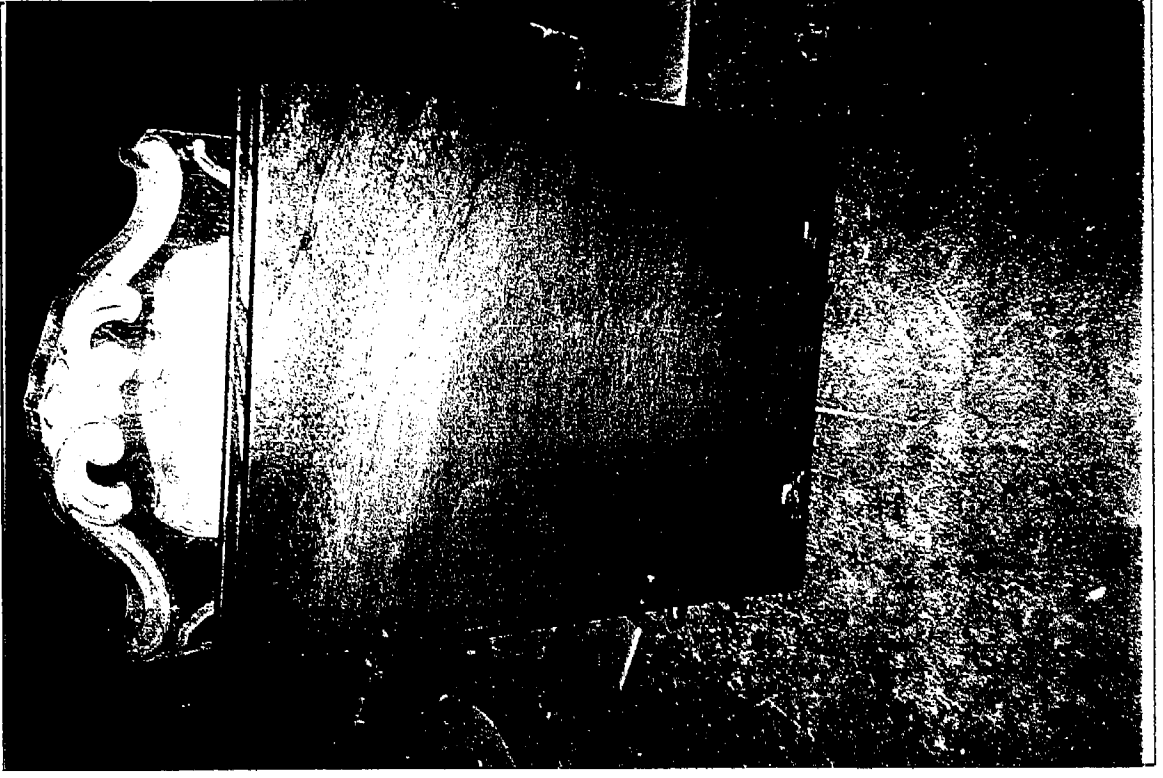


Figure 3-31: Drawer Stripped with B25 Stripper at Strip Joint

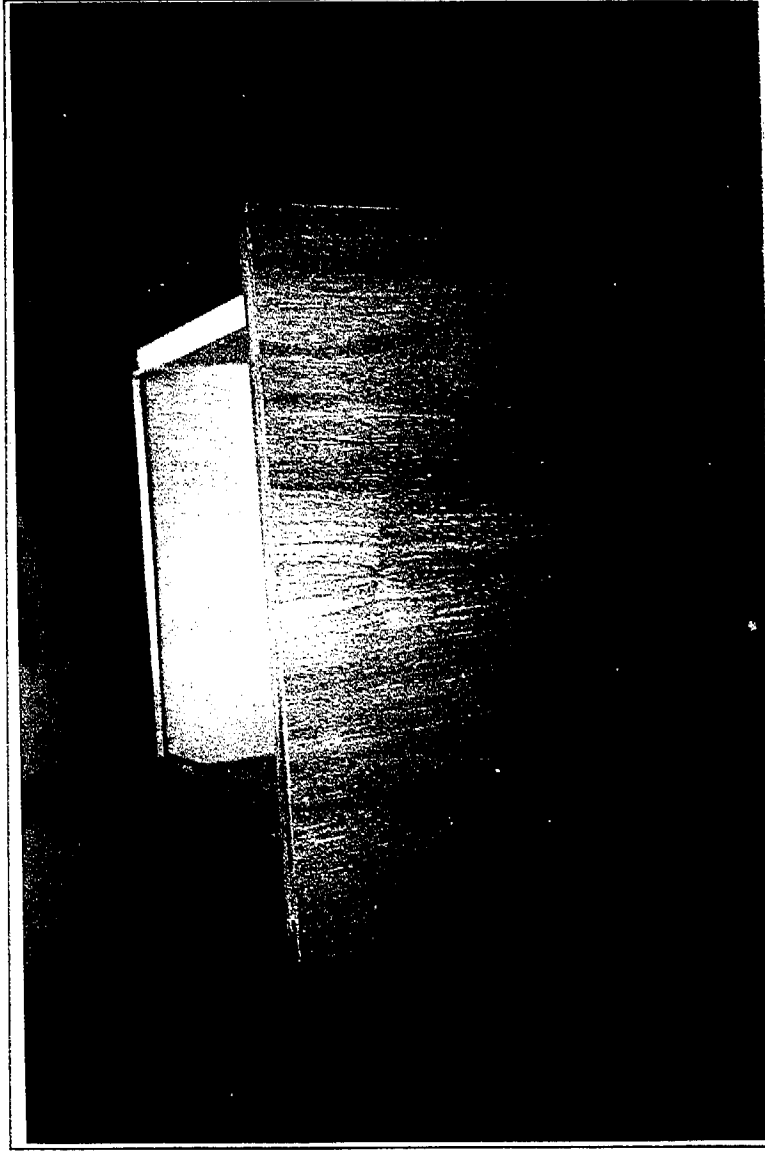


Figure 3-32: Drawer Stripped with B25 Stripper at Strip Joint

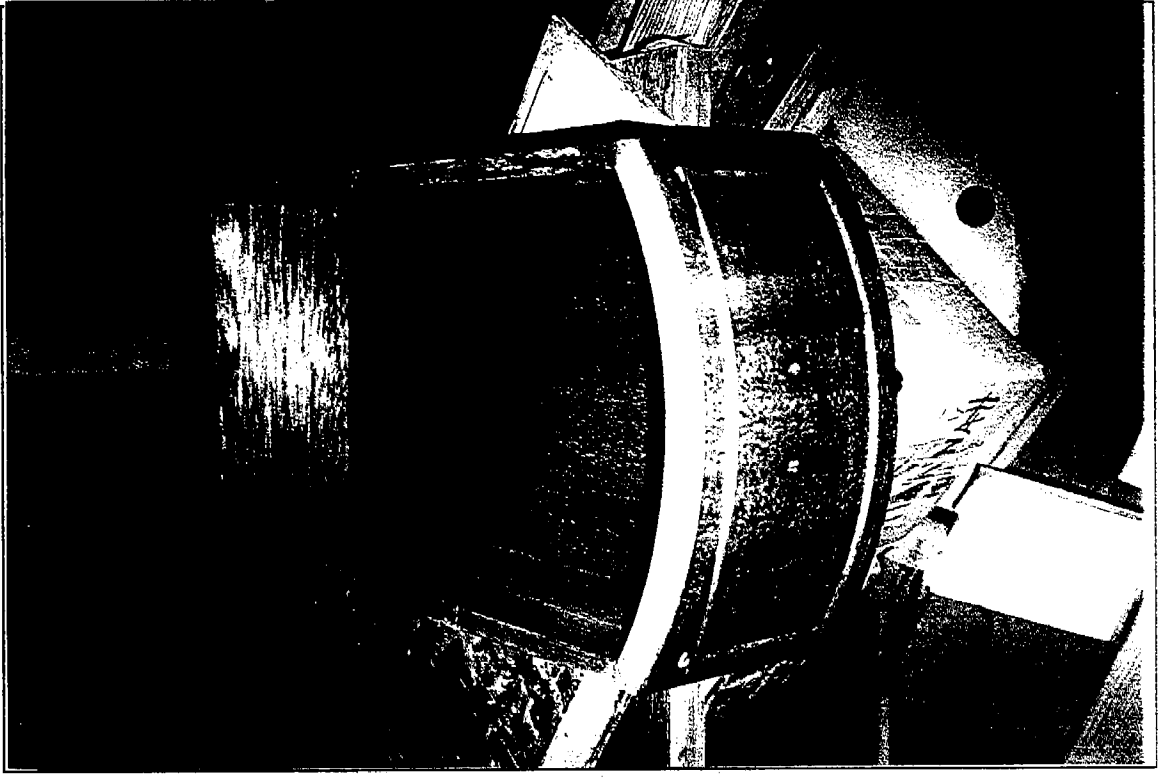


Figure 3-33. Chair Base Stripped with B25  
Stripper at Strip Joint



Figure 3-34. Chair Stripped with B25  
Stripper at Strip Joint

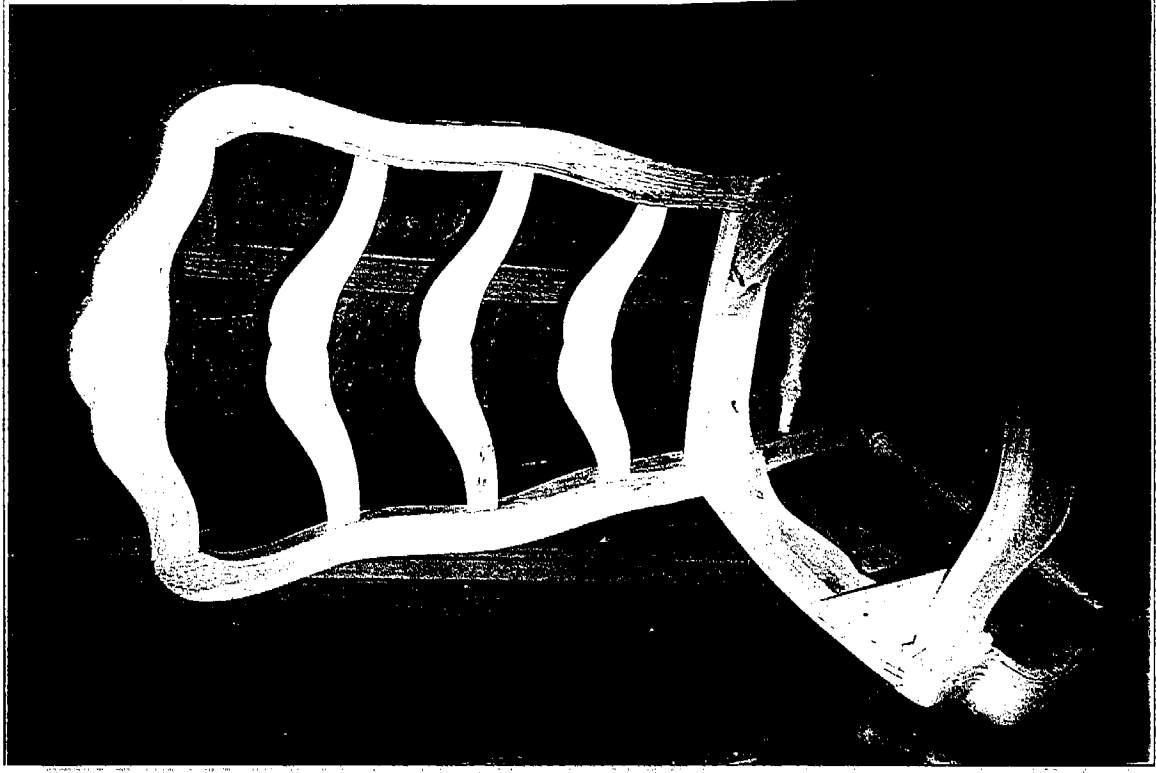


Figure 3-35: Door Stripped with B25  
Stripper at Strip Joint

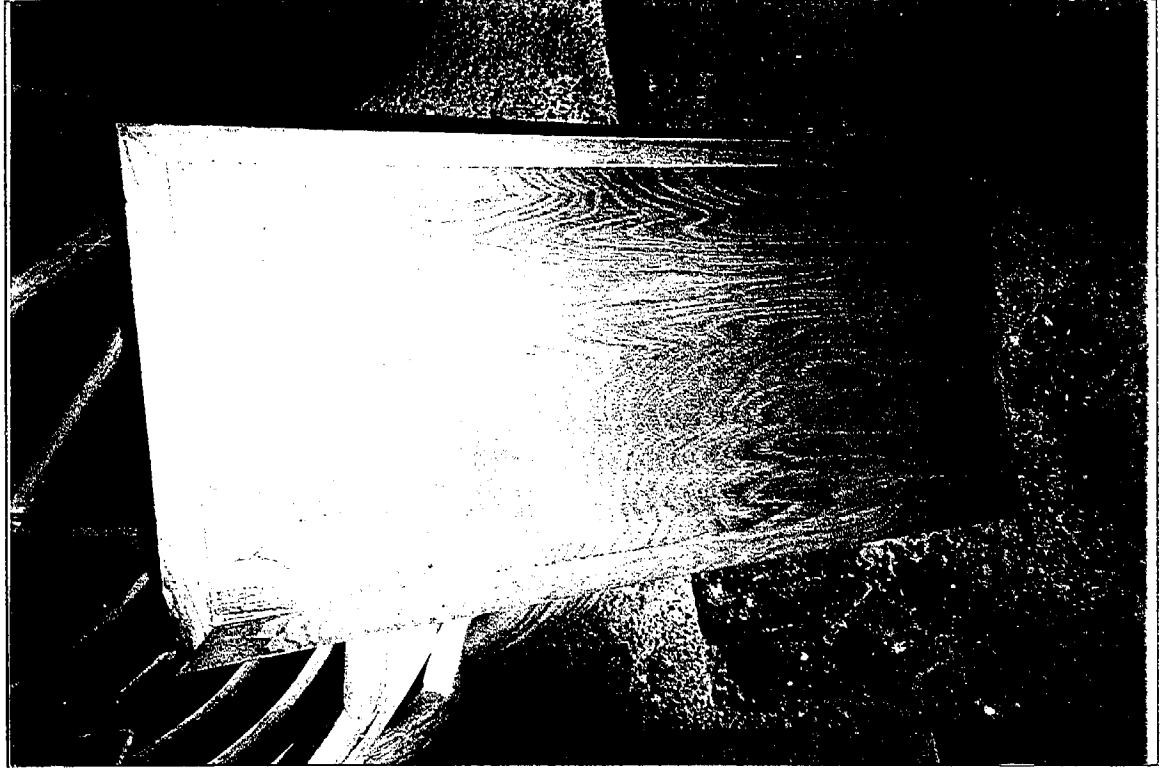


Figure 3-36: Door Stripped with B25  
Stripper at Strip Joint

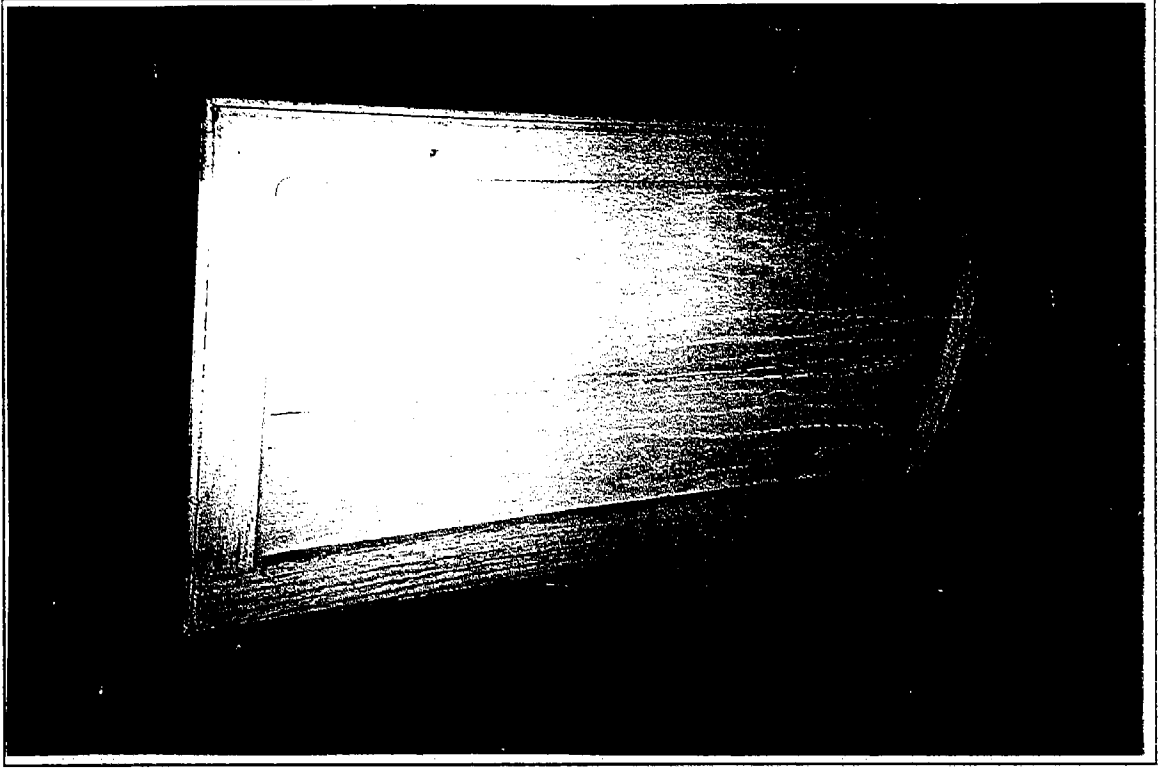


Figure 3-37. Drawer Stripped with CAE2 Stripper at Strip Joint

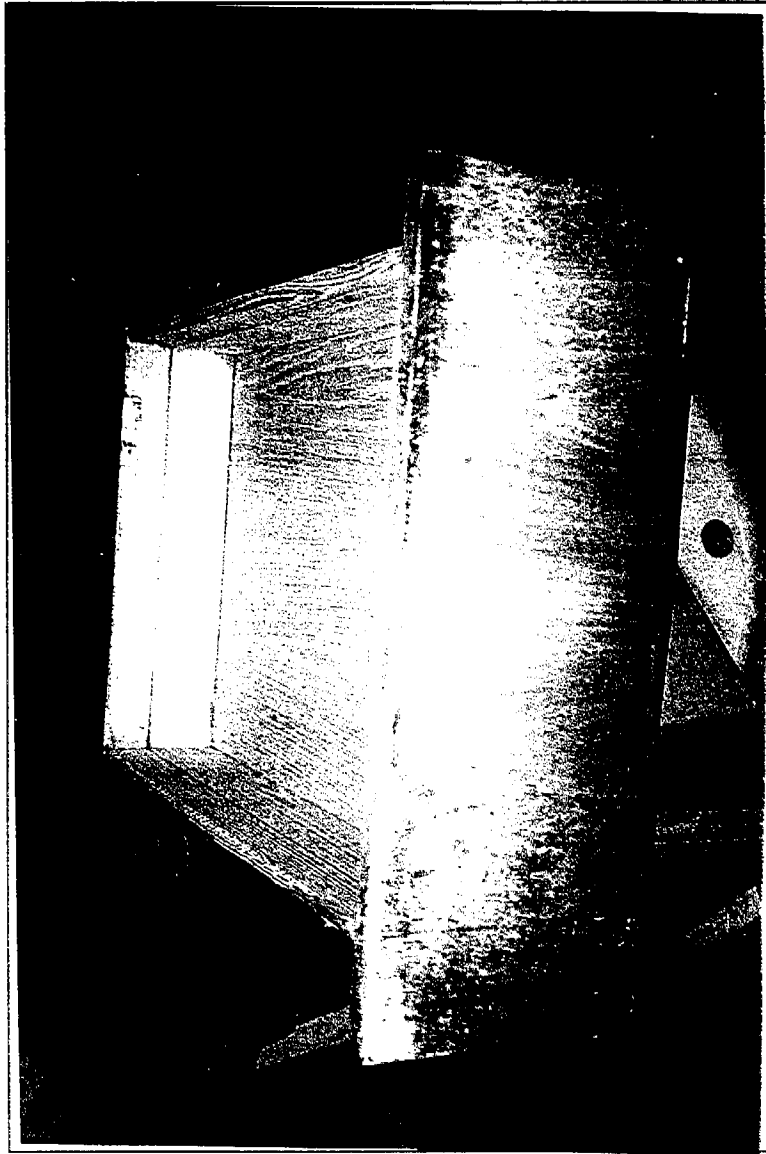


Figure 3-38: Drawer Stripped with CAE2 Stripper at Strip Joint

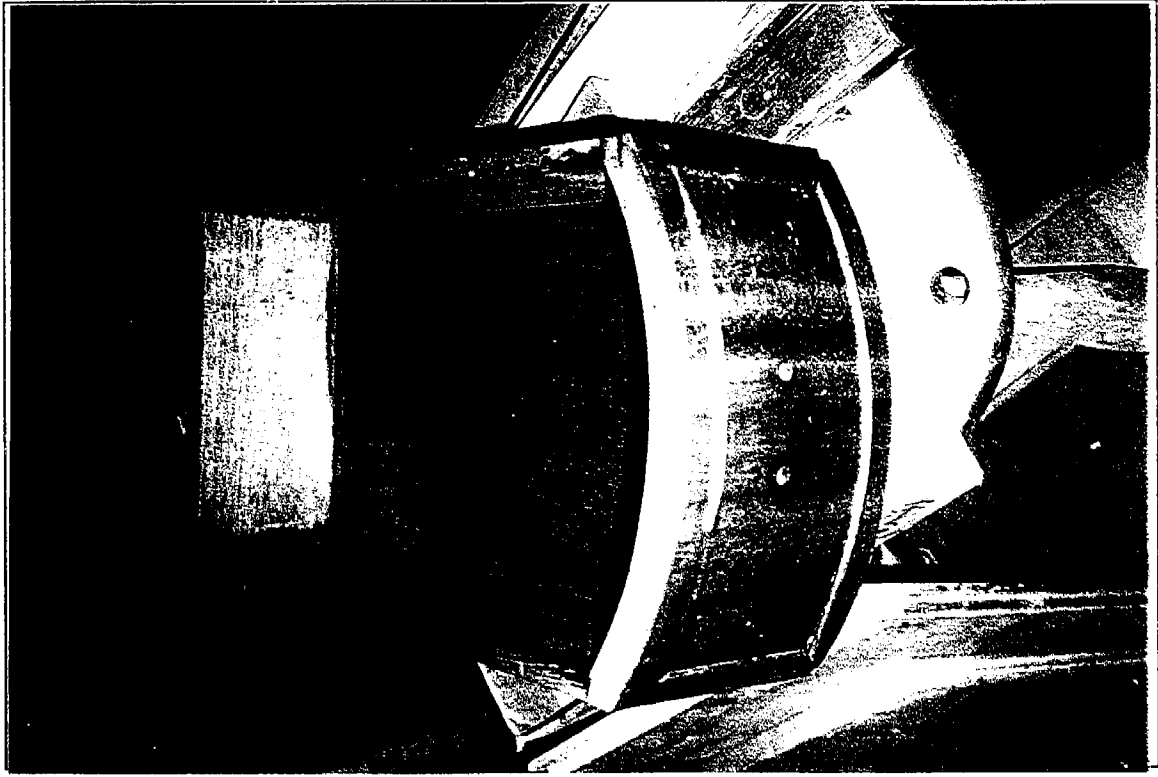




Figure 3-39: Chair Stripped with CAIE2  
Stripper at Strip Joint

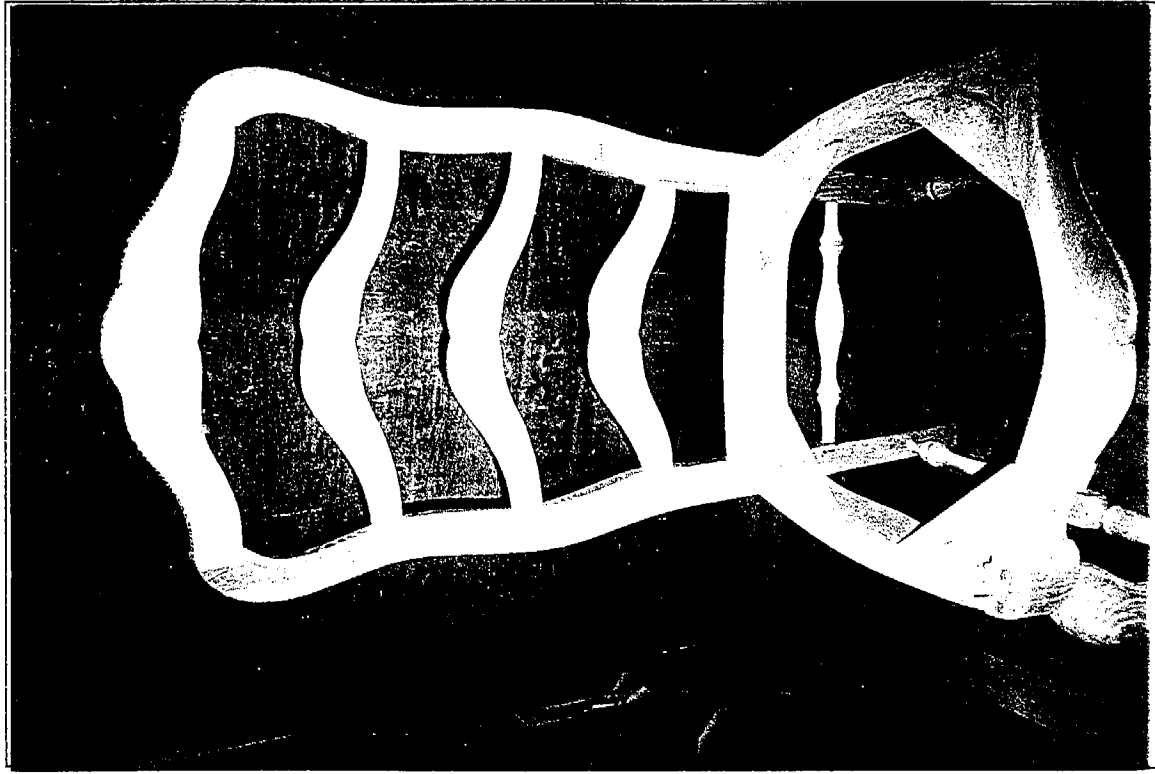


Figure 3-40: Chair Stripped with CAIE2  
Stripper at Strip Joint

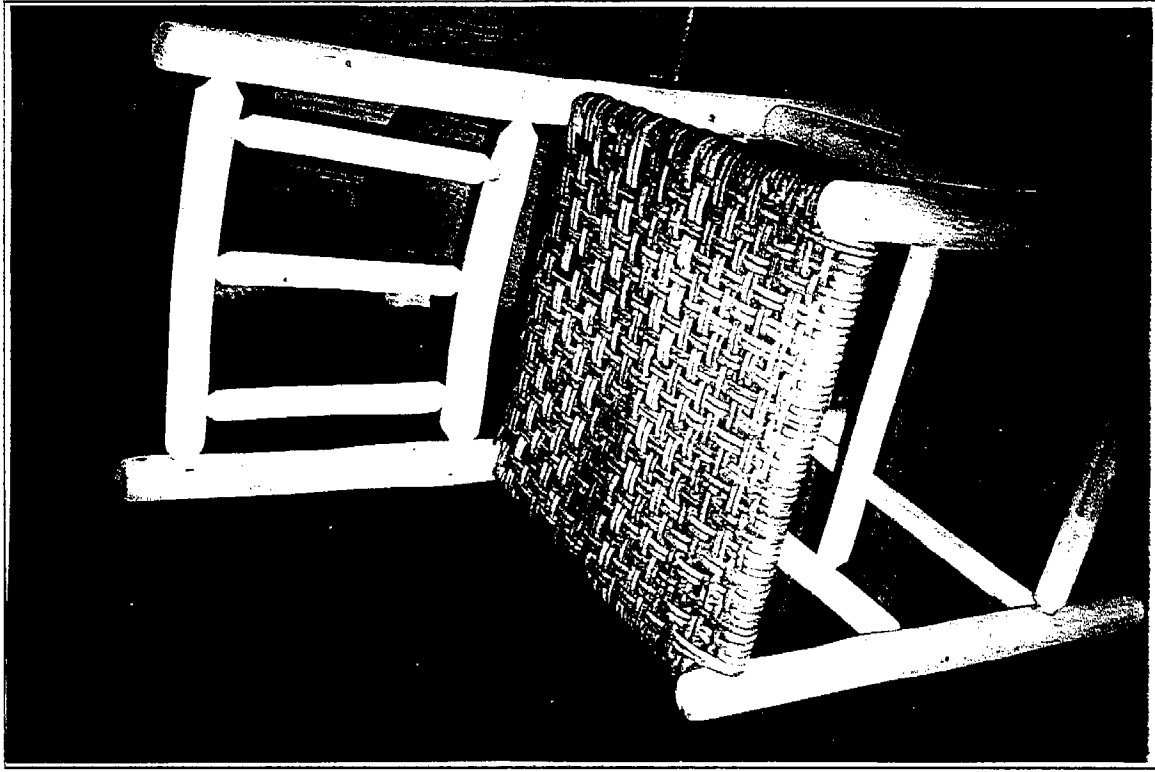


Figure 3-41: Door Stripped with CAE2  
Stripper at Strip Joint

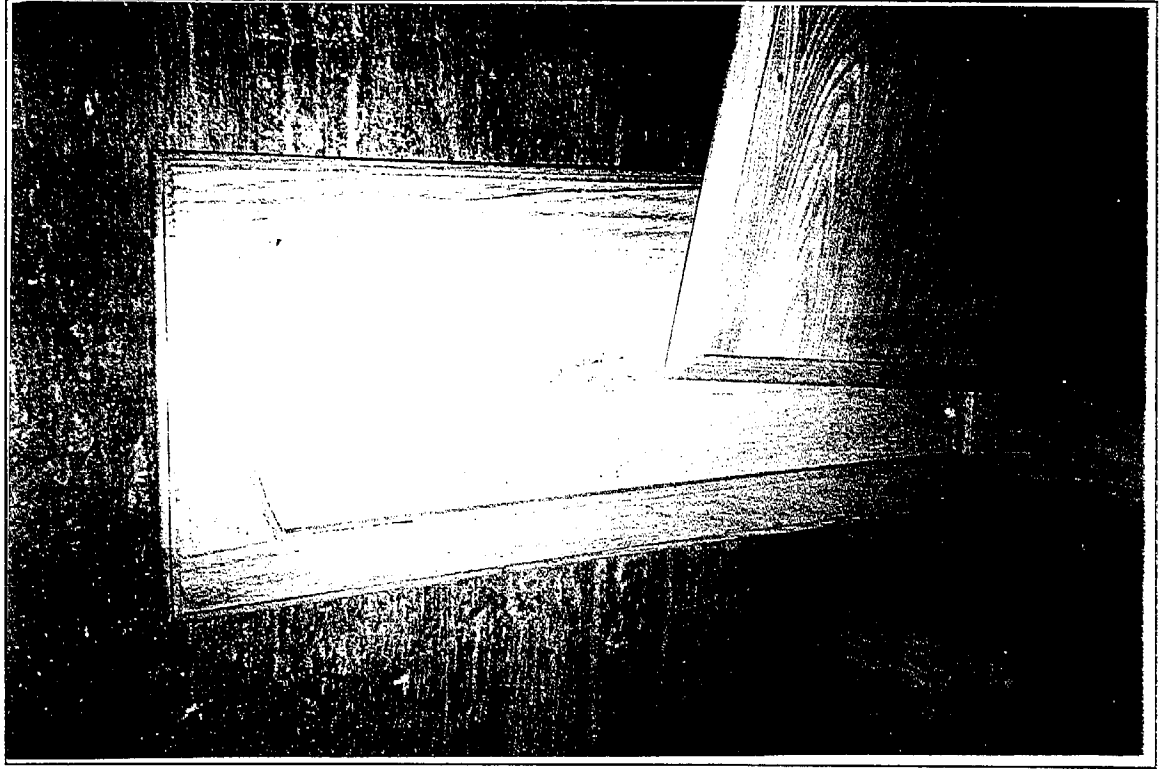


Figure 3-42: Door Stripped with CAE2  
Stripper at Strip Joint

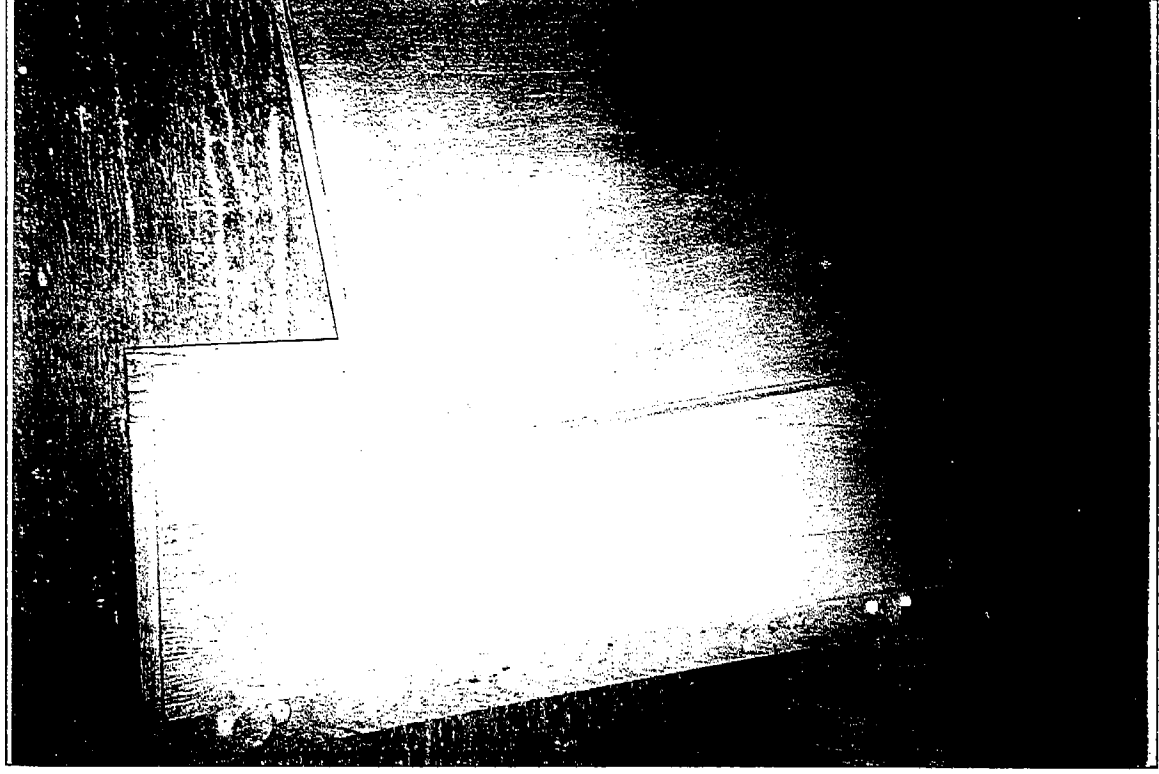


Figure 3-43: Drawer Stripped with CAE3 Stripper at Strip Joint

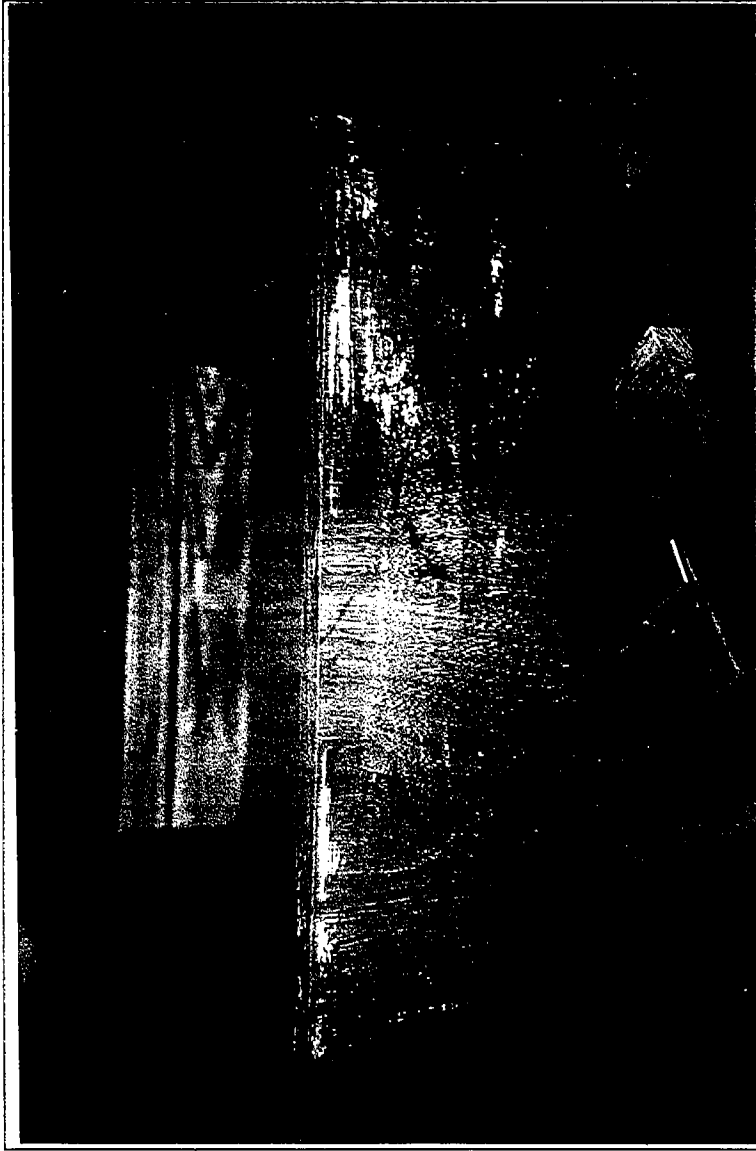


Figure 3-44: Drawer Stripped with CAE3 Stripper at Strip Joint



Figure 3-45: Chair Stripped with CAE3  
Stripper at Strip Joint

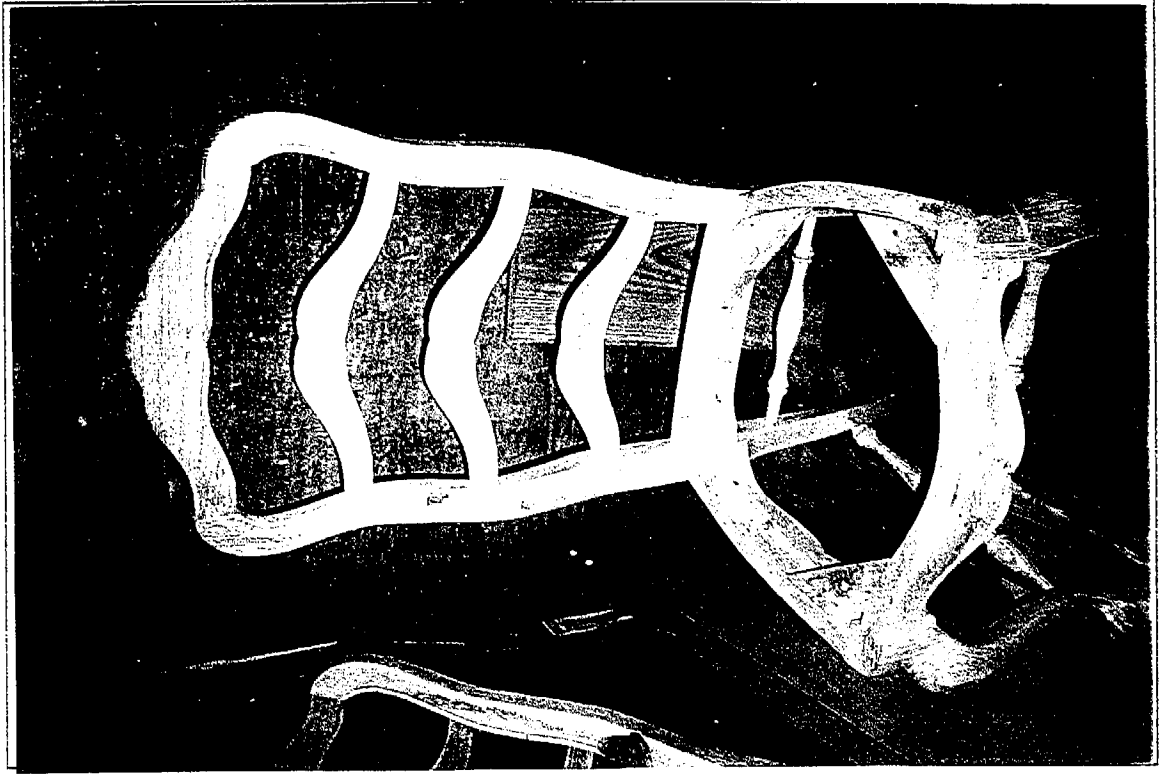


Figure 3-46: Chair Stripped with CAE3  
Stripper at Strip Joint

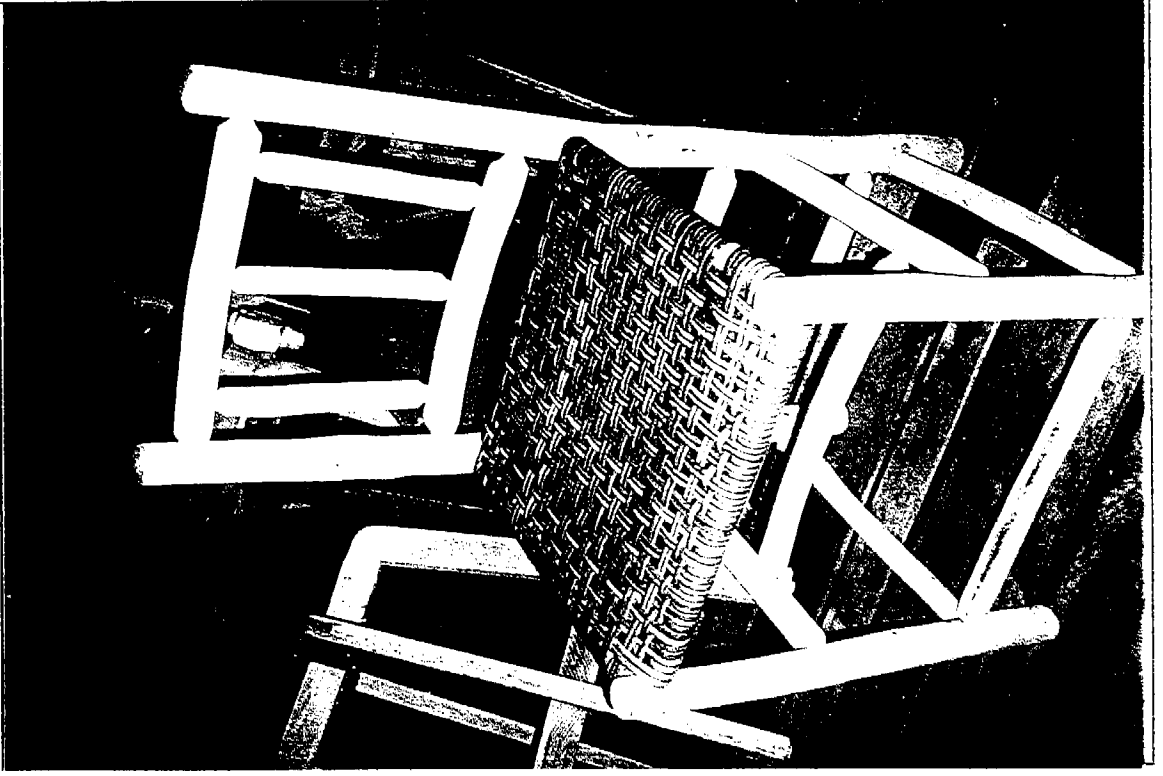


Figure 3-47: Door Stripped with CAE3  
Stripper at Strip Joint

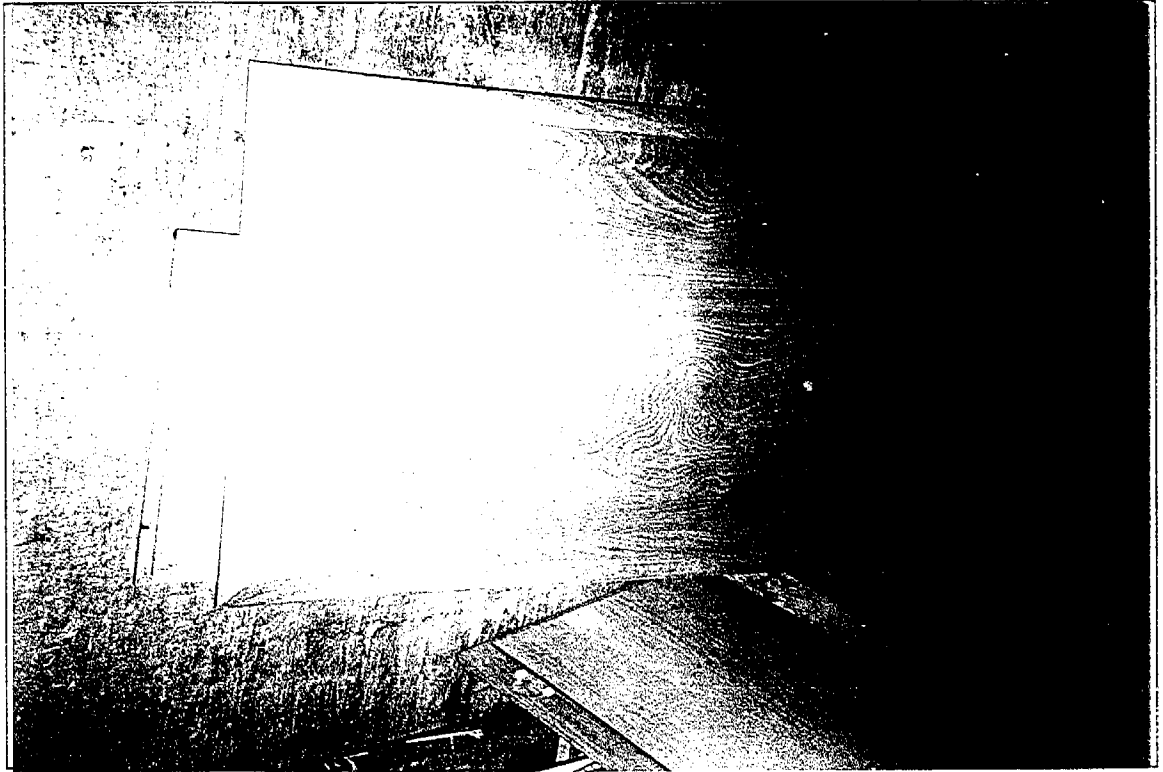
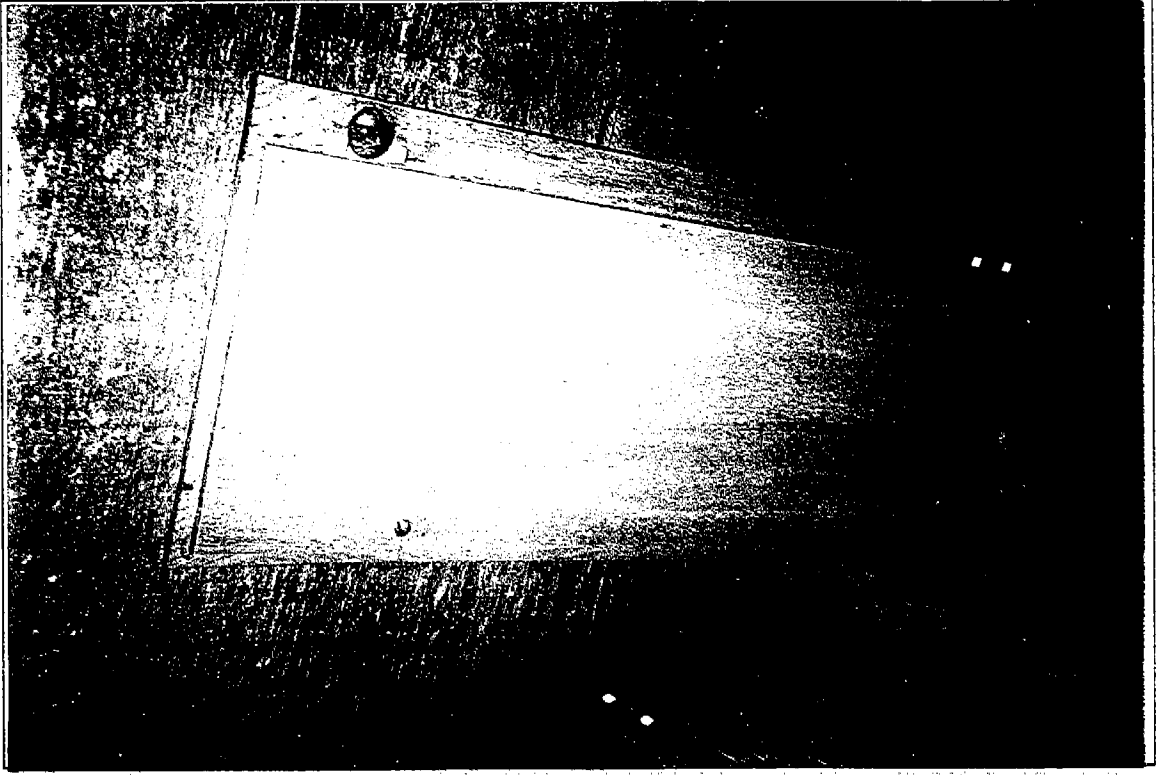


Figure 3-48: Door Stripped with CAE3  
Stripper at Strip Joint



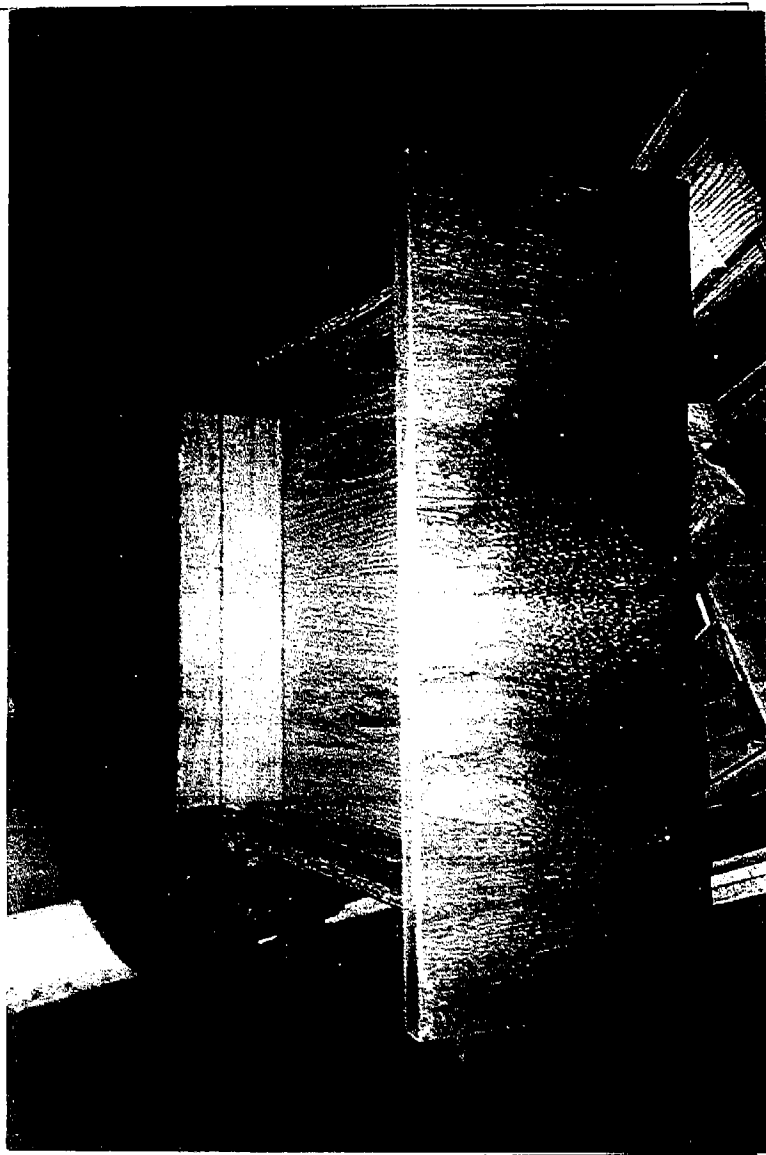


Figure 3-49: Drawer with CAE4 Stripper at Strip Joint



Figure 3-50: Drawer Stripped with CAE4 Stripper at Strip Joint

Figure 3-51: Chair Stripped with CAE4 Stripper at Strip Joint

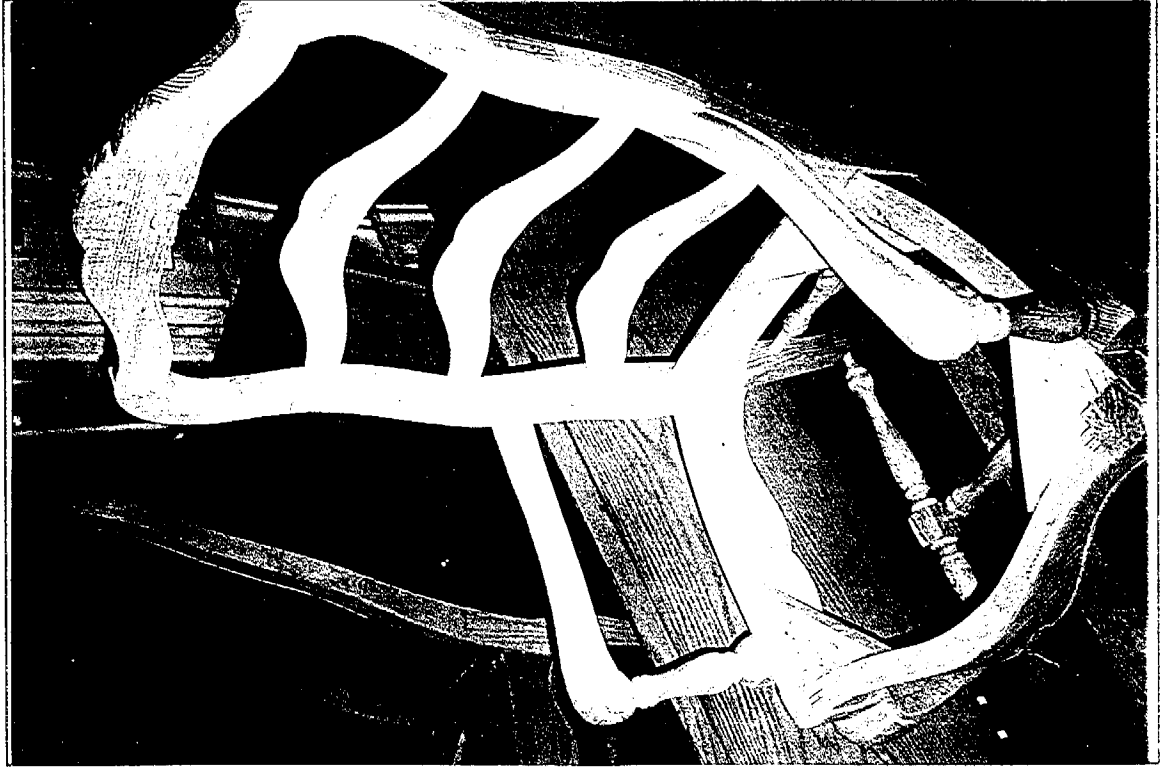


Figure 3-52: Chair Base Stripped with CAE4 at Strip Joint

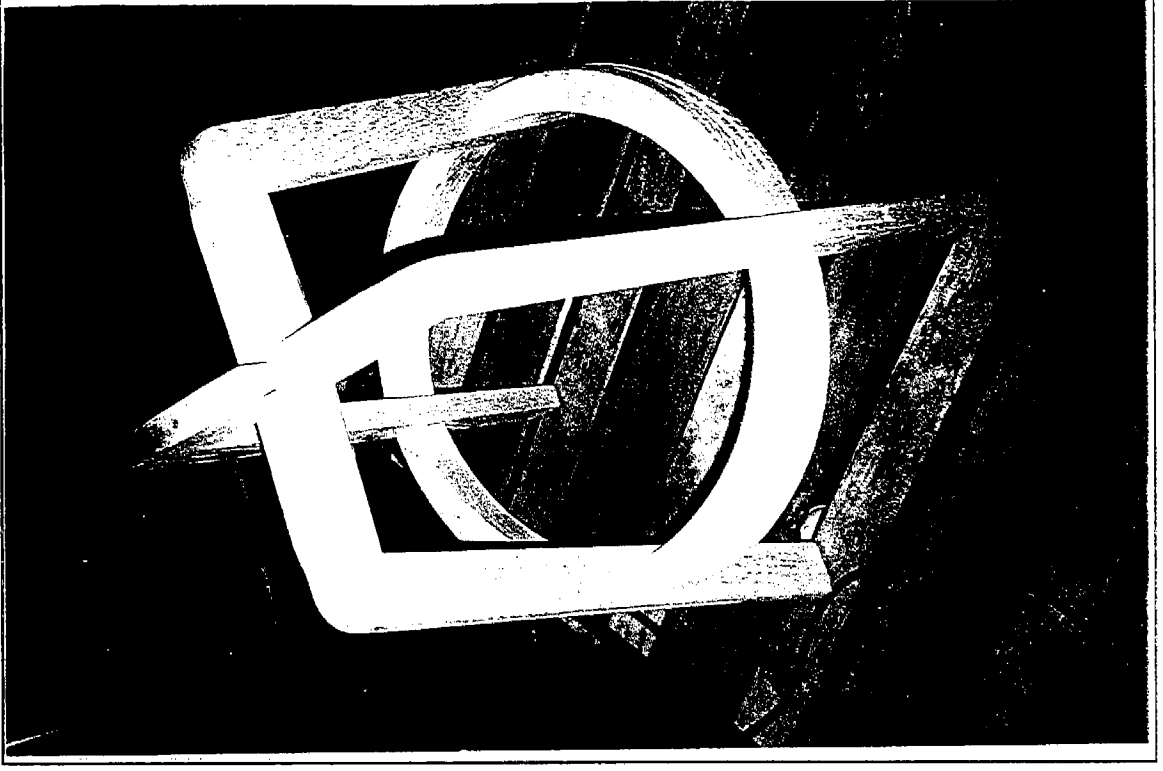


Figure 3-53: Door Stripped with CAE4  
Stripper at Strip Joint

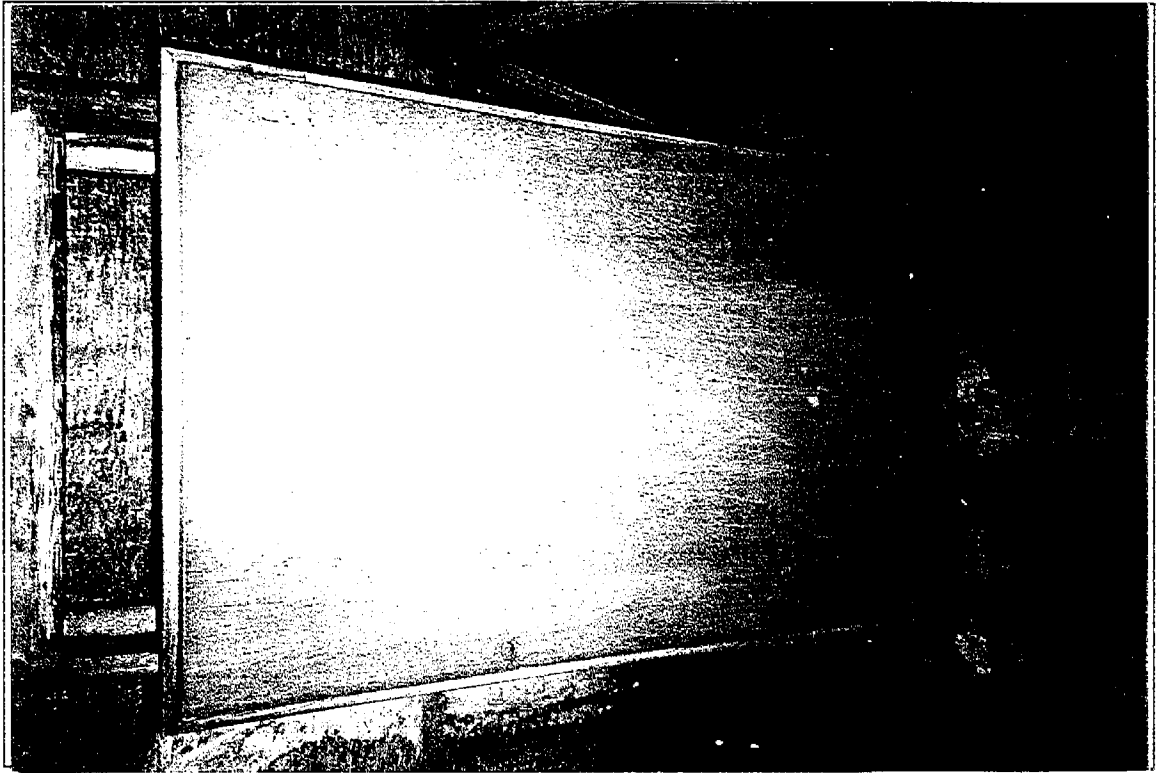


Figure 3-54: Door Stripped with CAE4  
Stripper at Strip Joint

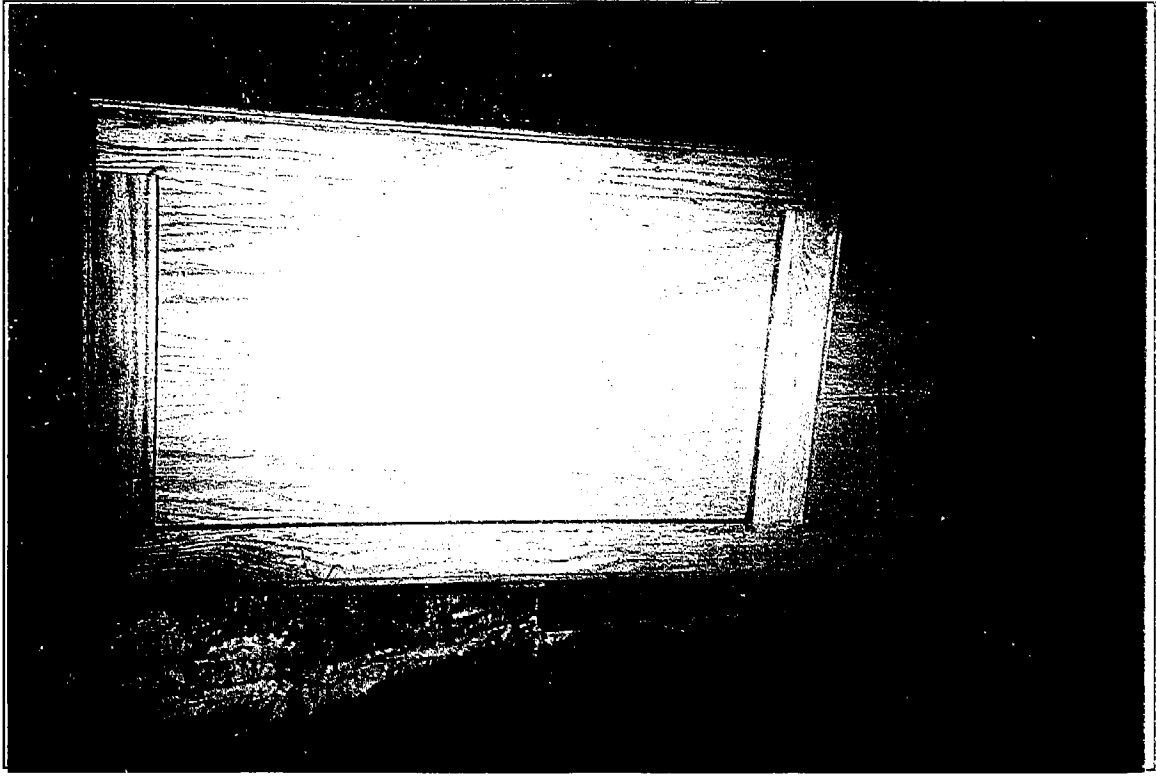




Figure 3-55: Drawer Stripped with CAE7 Stripper at Strip Joint

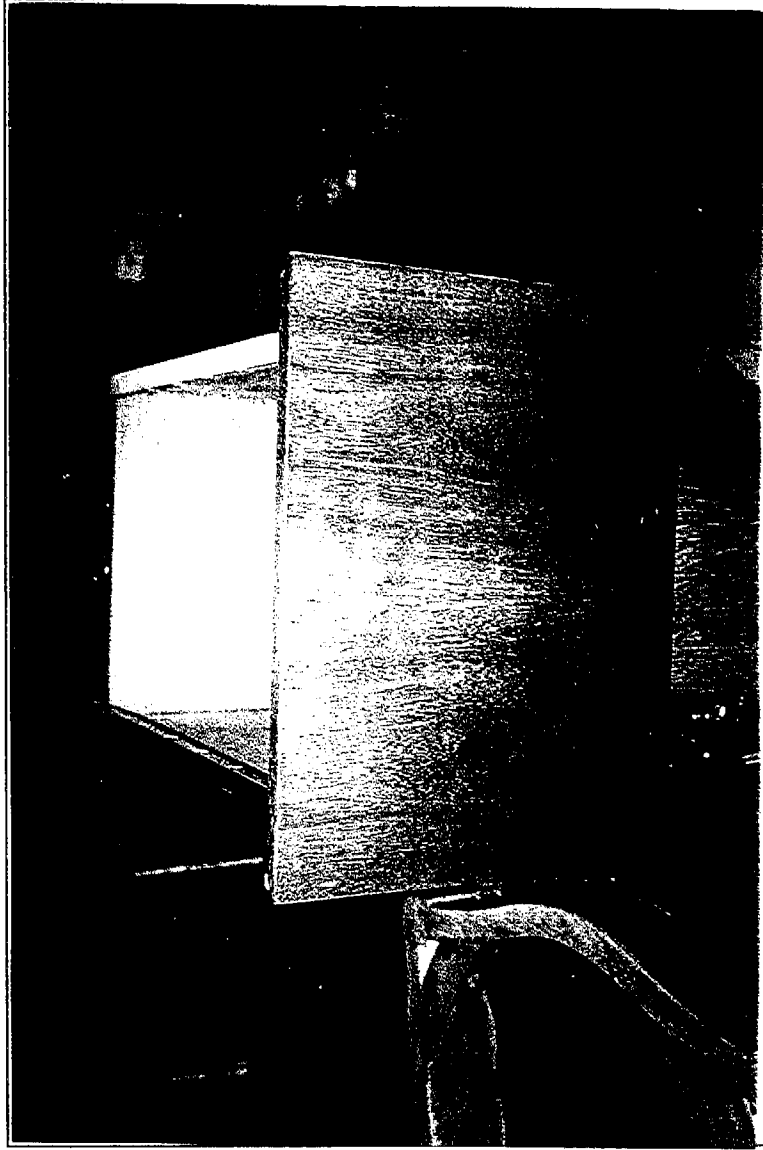


Figure 3-56: Drawer Stripped with CAE7 Stripper at Strip Joint

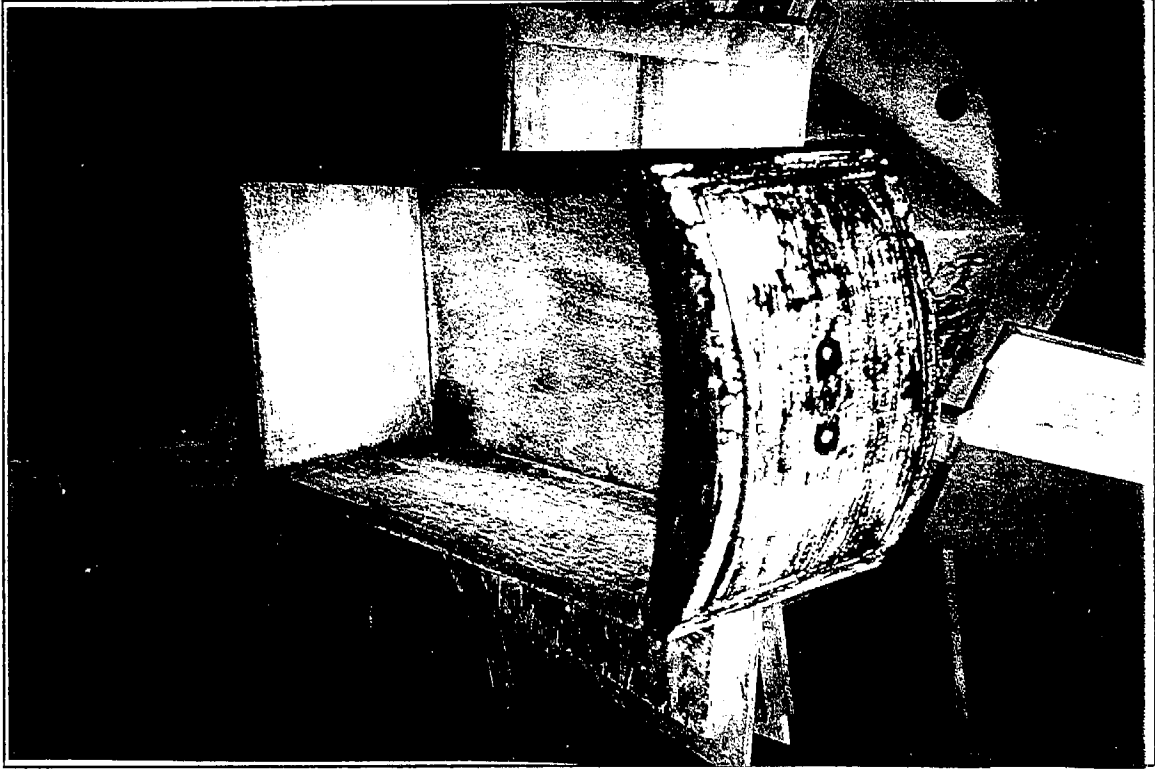


Figure 3-57: Chair Stripped with CAE7  
Stripper at Strip Joint

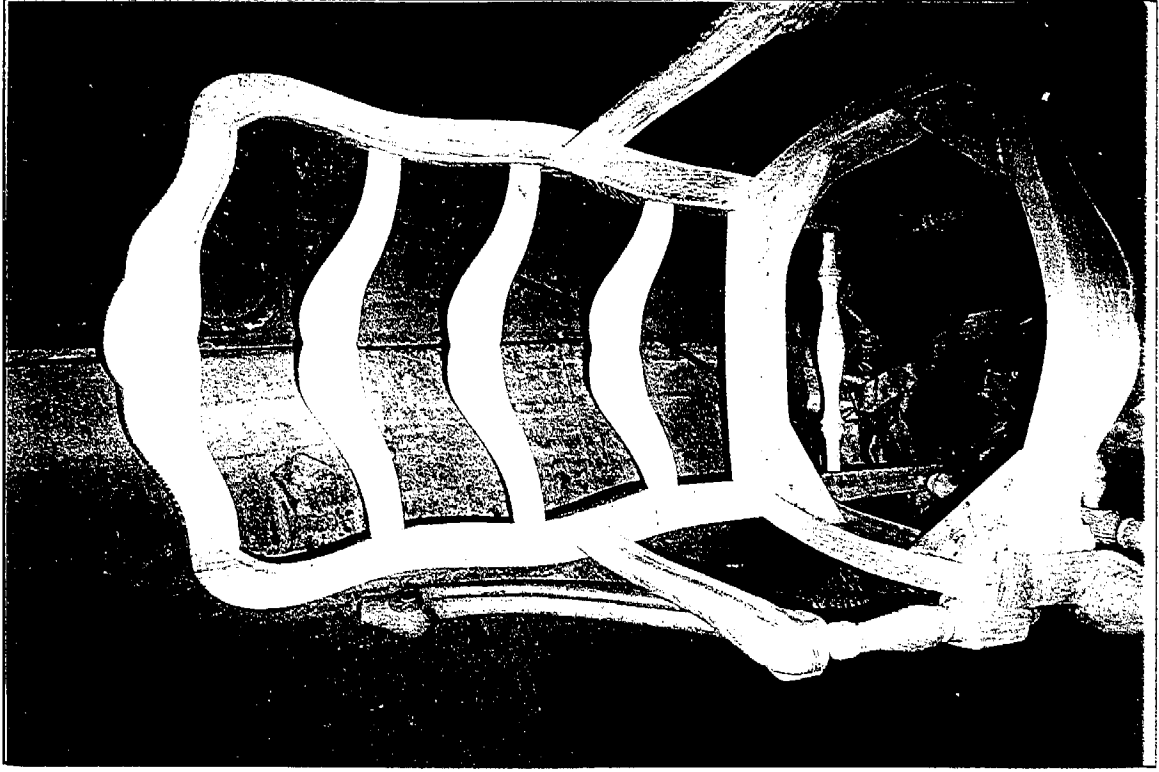


Figure 3-58: Chair Base Stripped with CAE7  
Stripper at Strip Joint

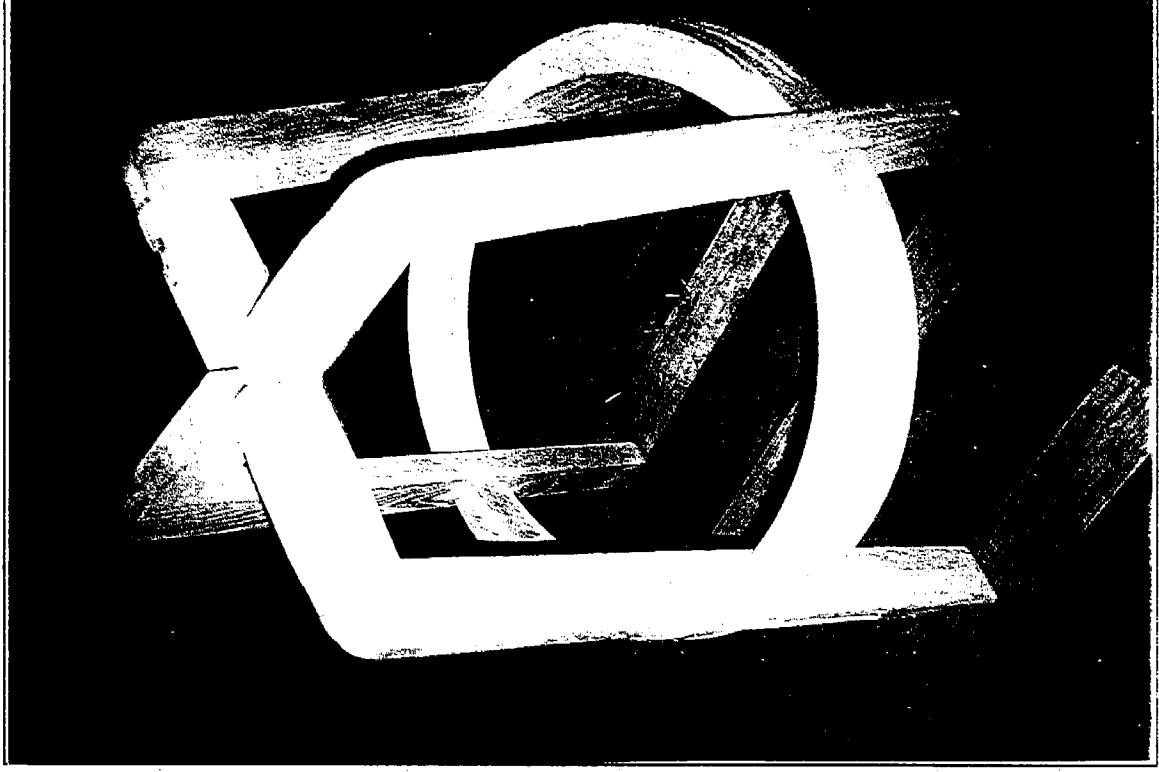


Figure 3-59: Door Stripped with CAE7  
Stripper at Strip Joint

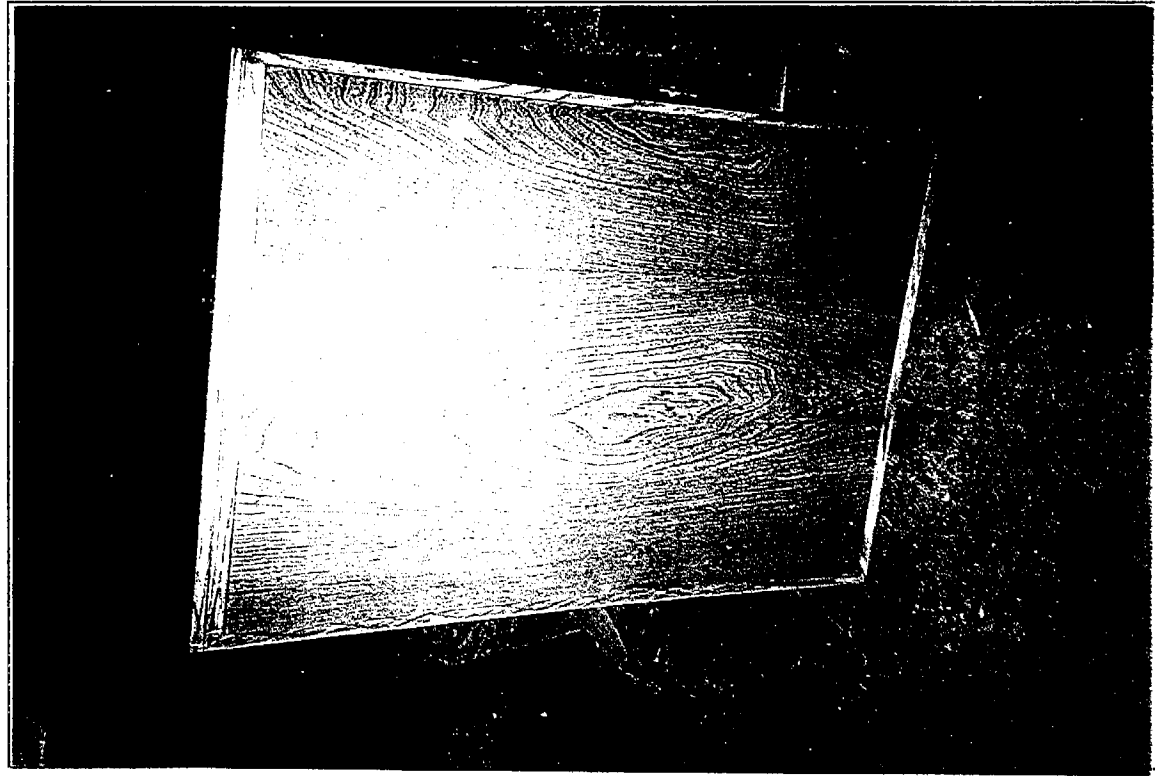


Figure 3-60: Door Stripped with CAE7  
Stripper at Strip Joint

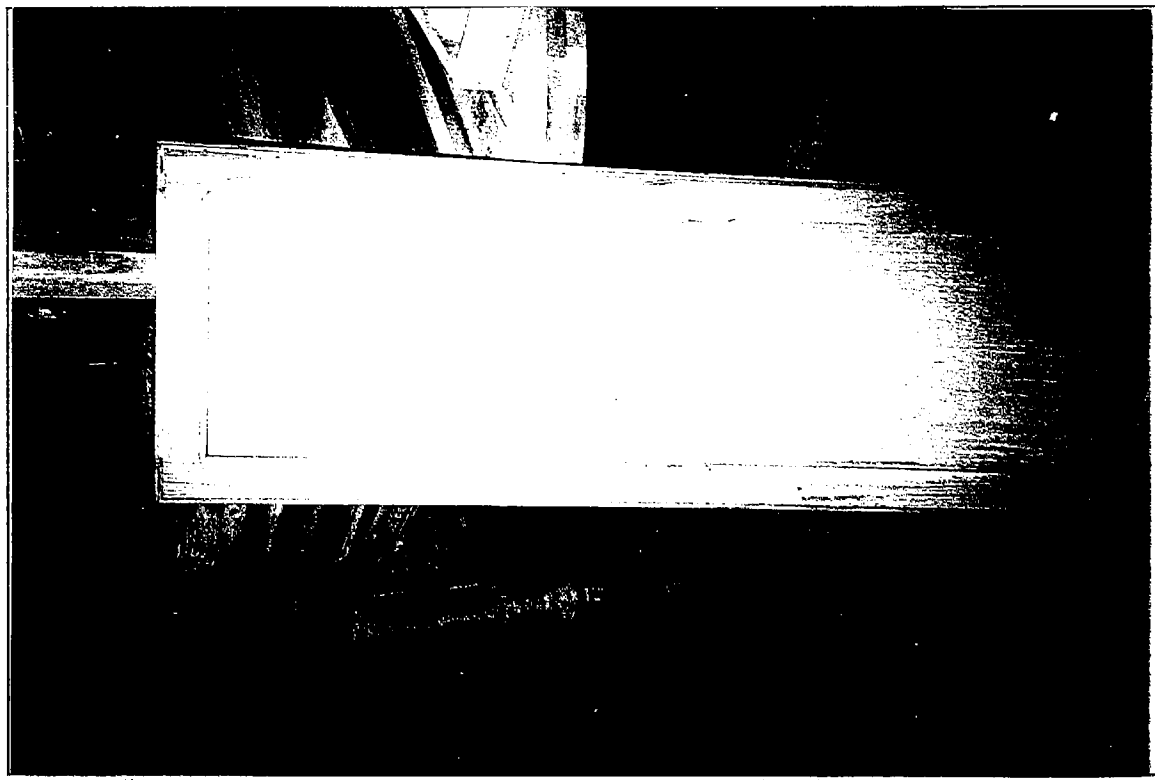


Figure 3-61· Stripped Furniture Drying at Strip Joint

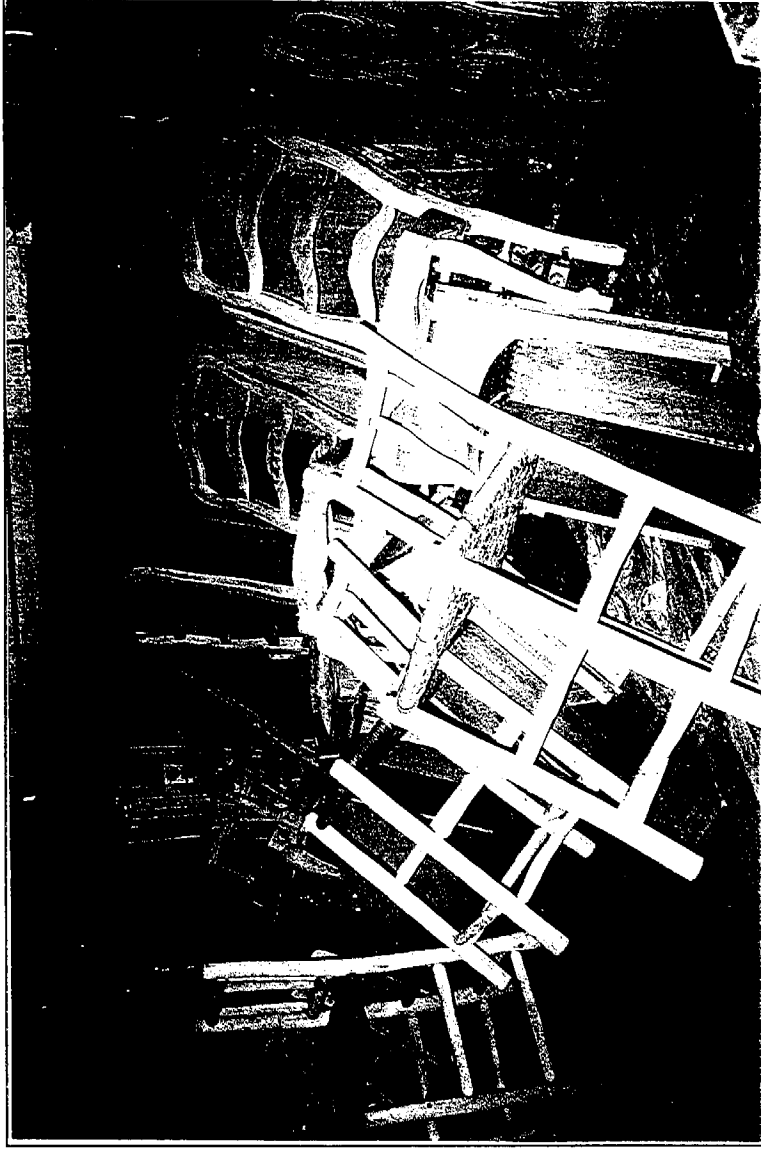


Figure 3-62: Flow Tray Used for Stripping at Sunset Strip



Figure 3-63: Another View of  
Flow Tray Used for Stripping  
at Sunset Strip



Figure 3-64: Water Wash Booth  
at Sunset Strip



Figure 3-65: Headboard Before Stripping  
at Sunset Strip

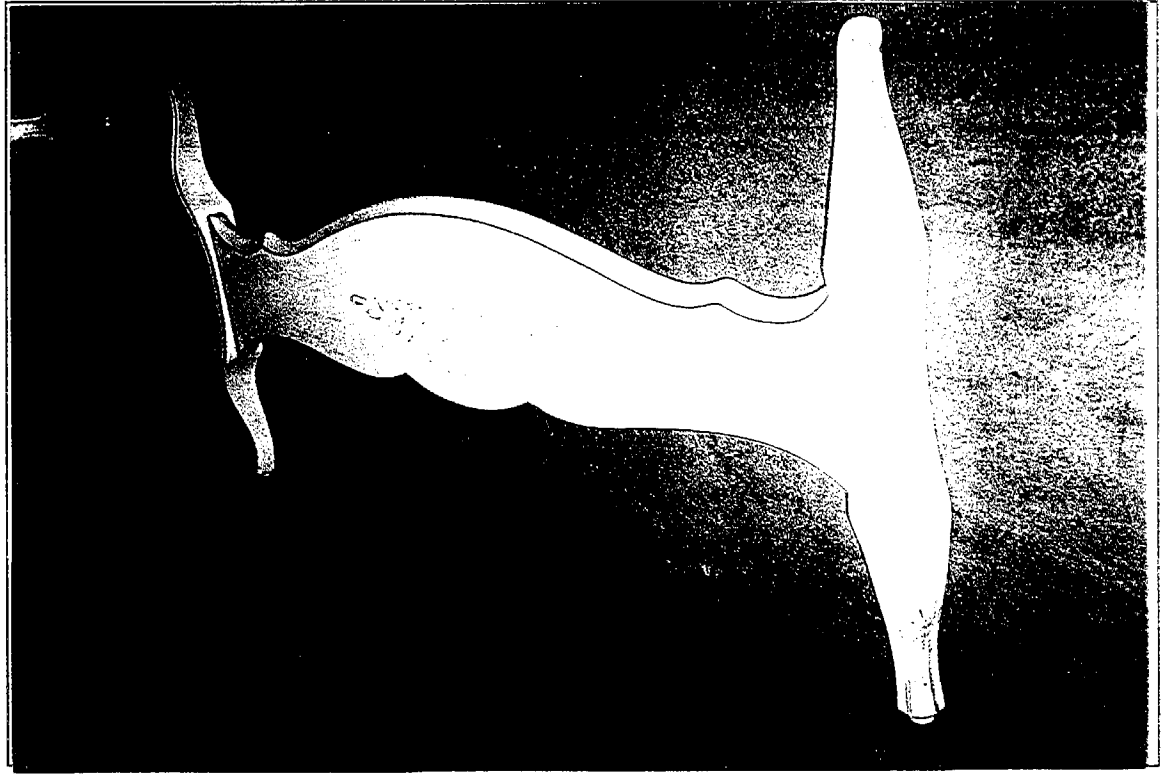


Figure 3-66: Drawer Before Stripping at Sunset Strip



Figure 3-67: Boat Step before Stripping at Sunset Strip

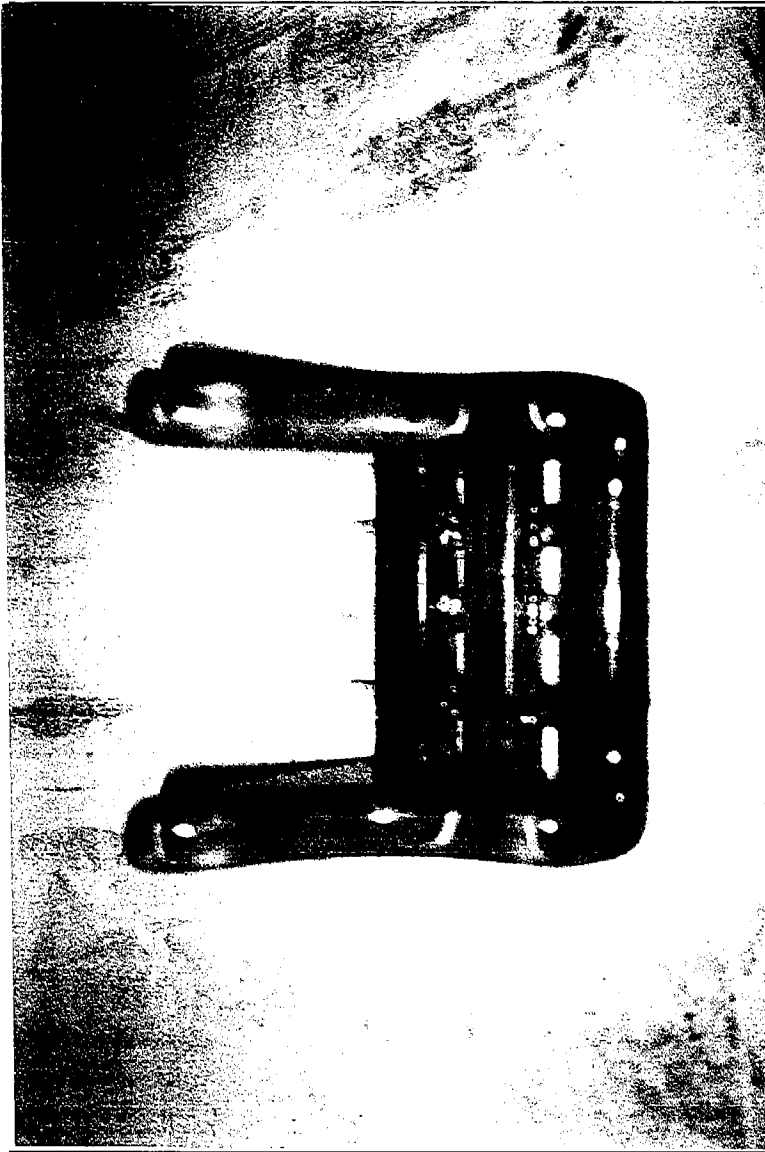


Figure 3-68: Drawer Before Stripping at Sunset Strip

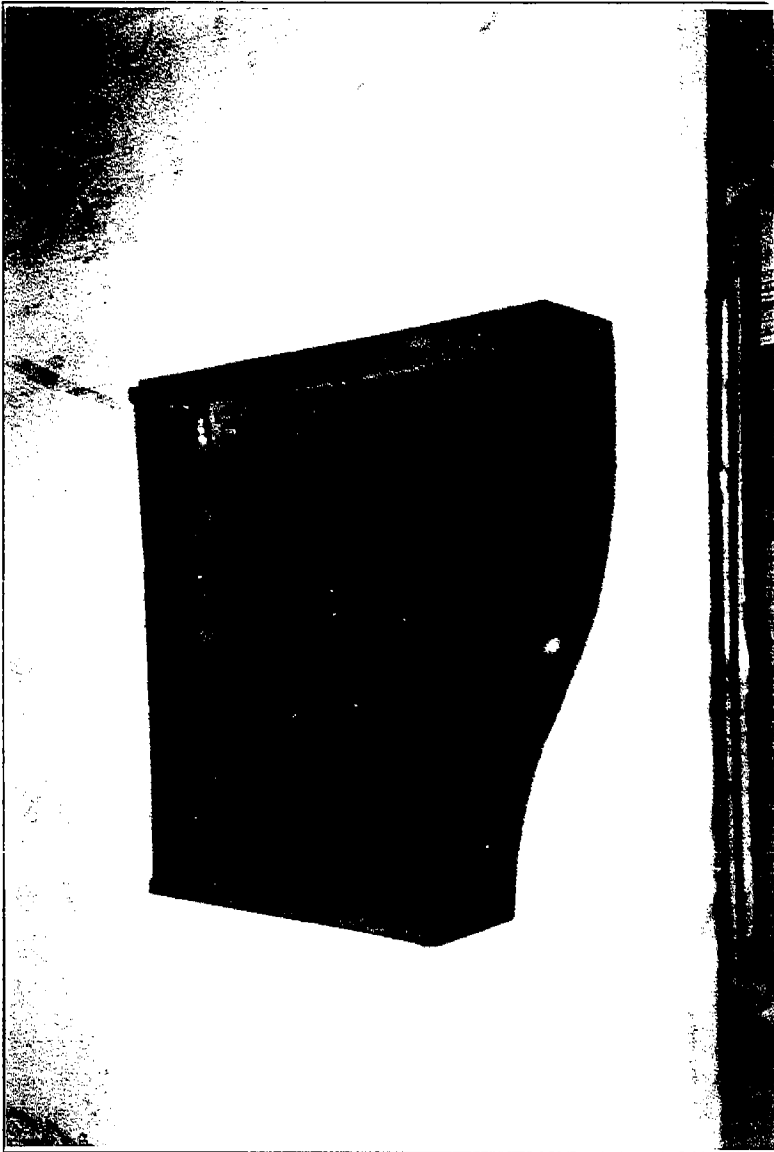


Figure 3-69: Door Before Stripping at Sunset Strip

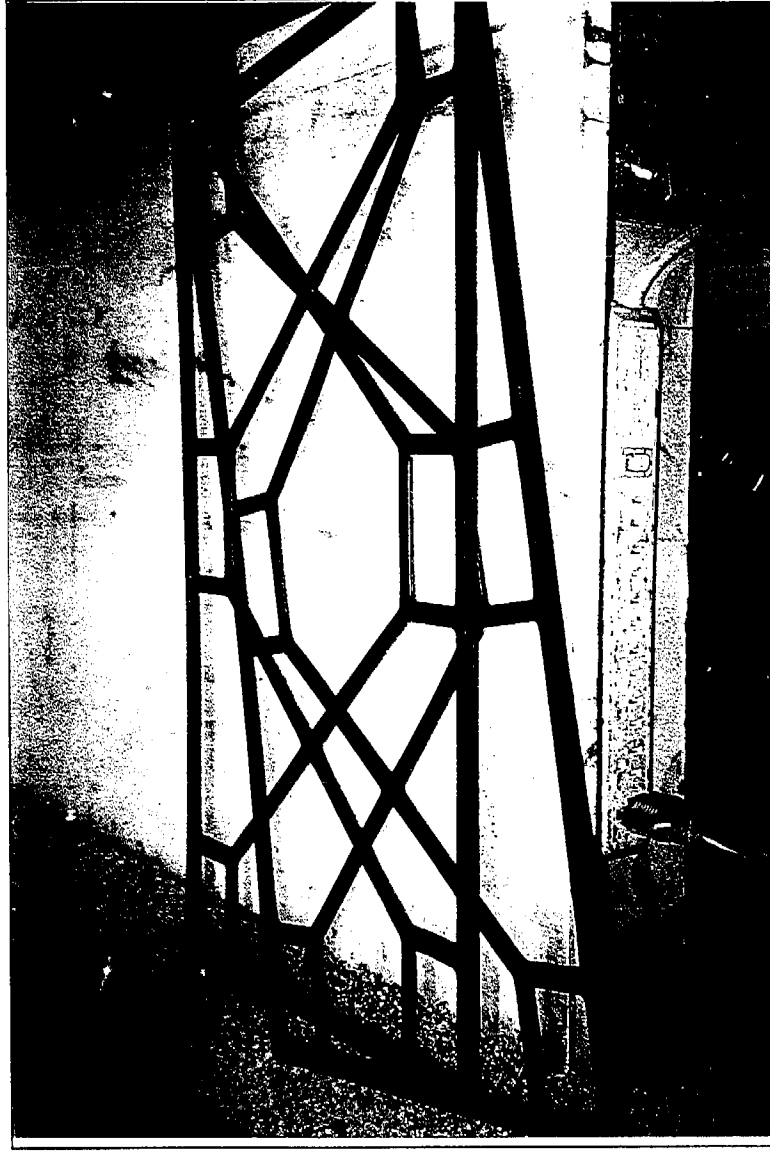


Figure 3-70: Drawer Before Stripping at Sunset Strip

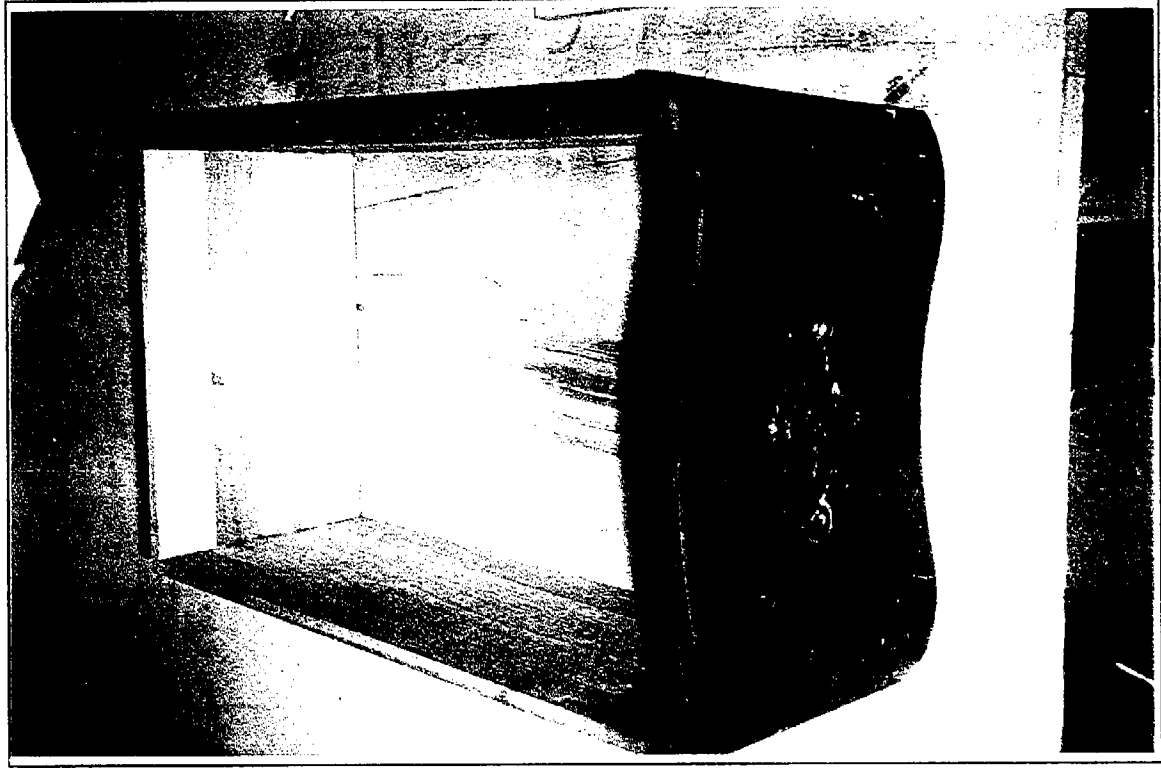




Figure 3-71: Items Stripped with B7  
Stripper at Sunset Strip

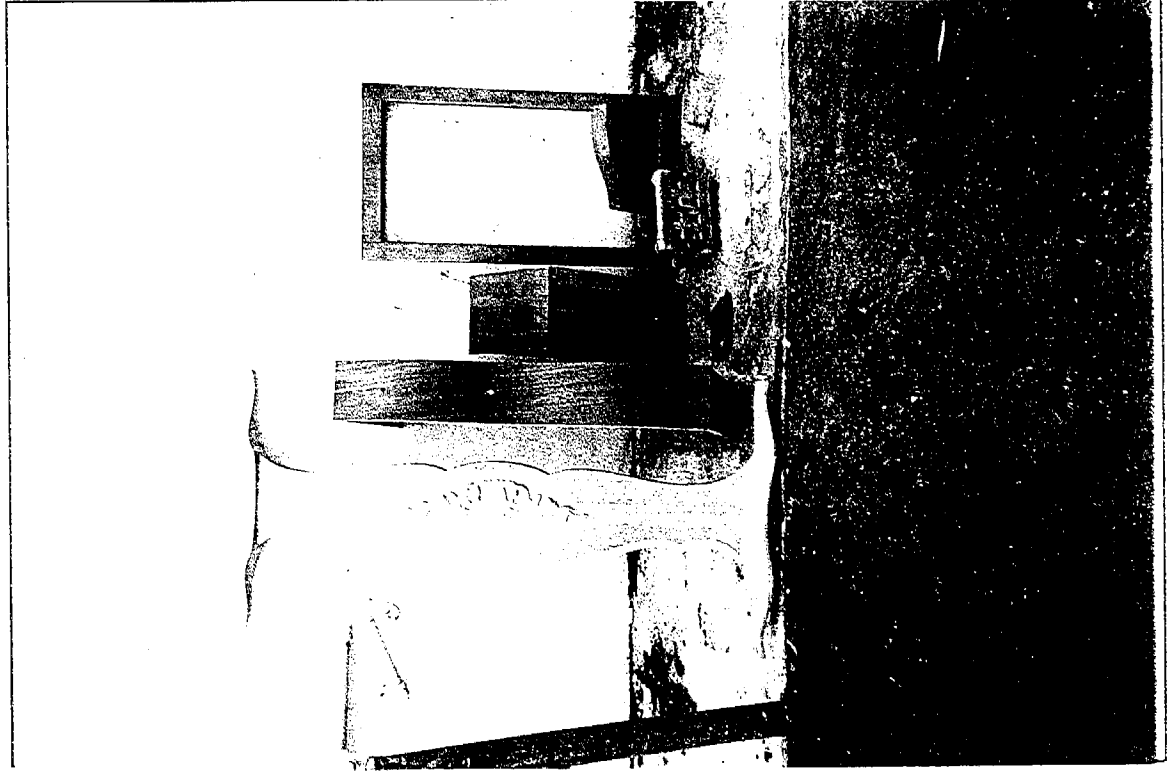


Figure 3-72: Items Stripped with B7 Stripper at Sunset Strip

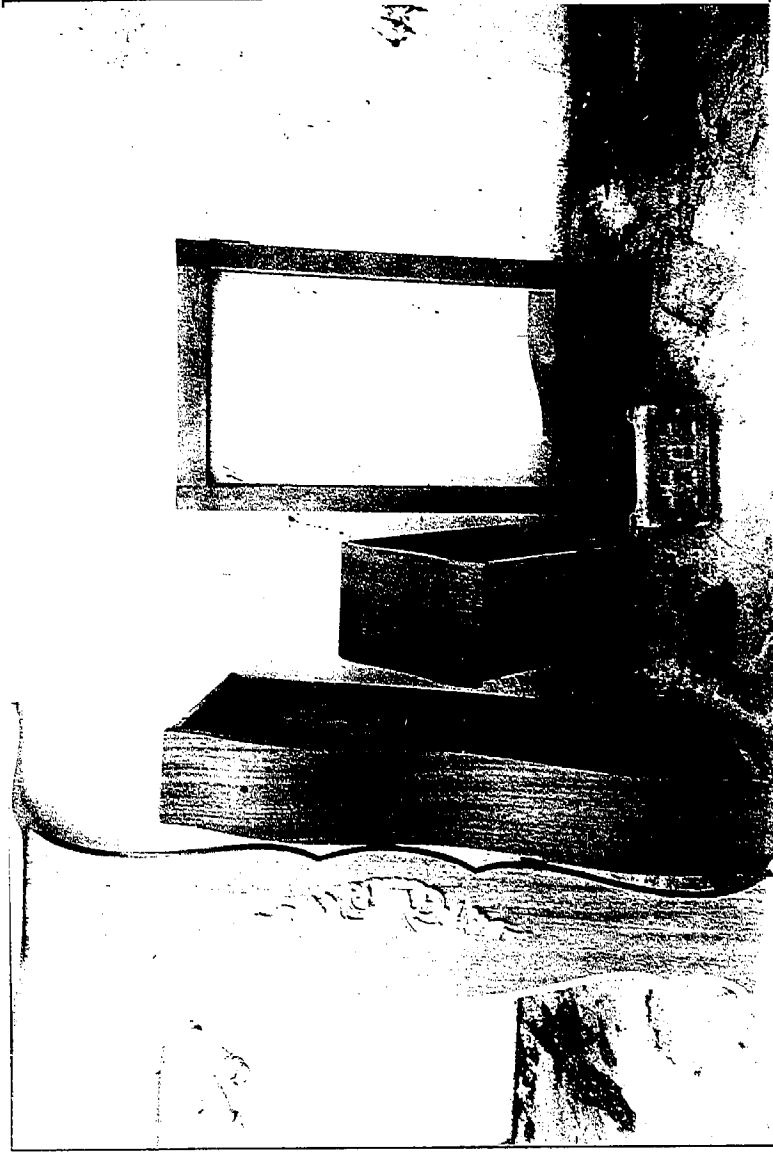


Figure 3-73: Items Stripped with B25  
Stripper at Sunset Strip

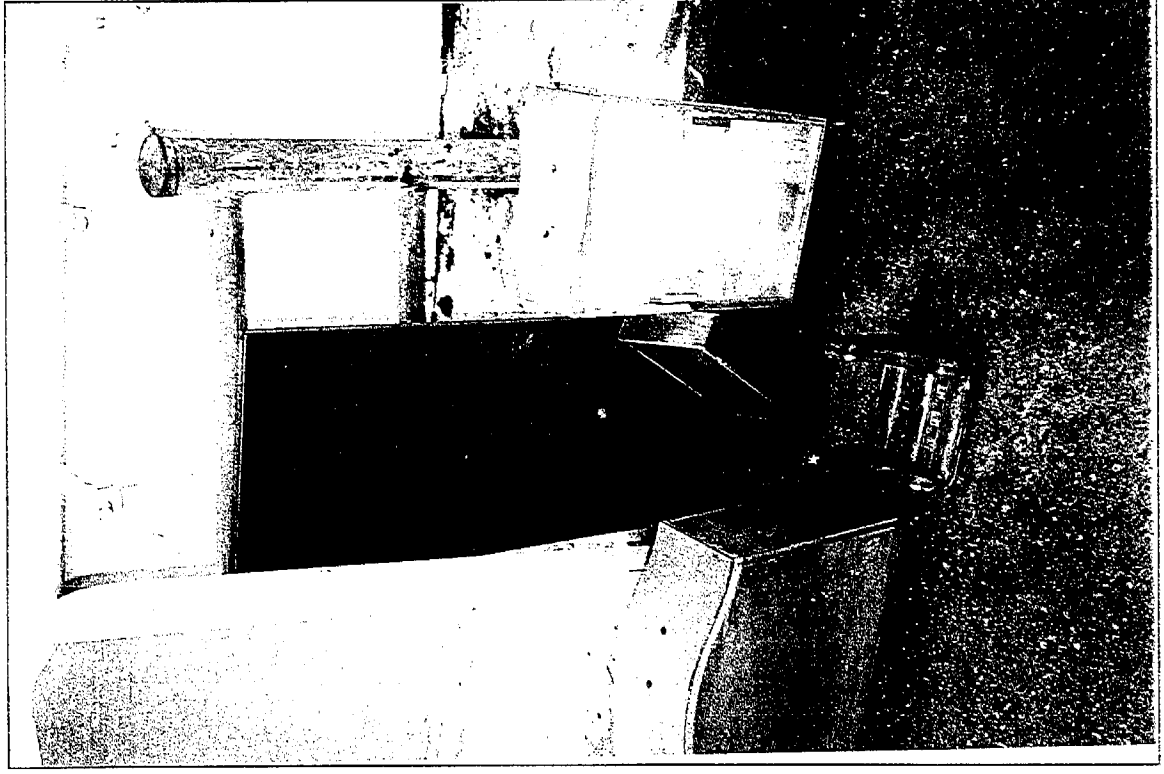


Figure 3-74: Items Stripped with B25  
Stripper at Sunset Strip



Figure 3-75 Items Stripped with B25 Stripper at Sunset Strip

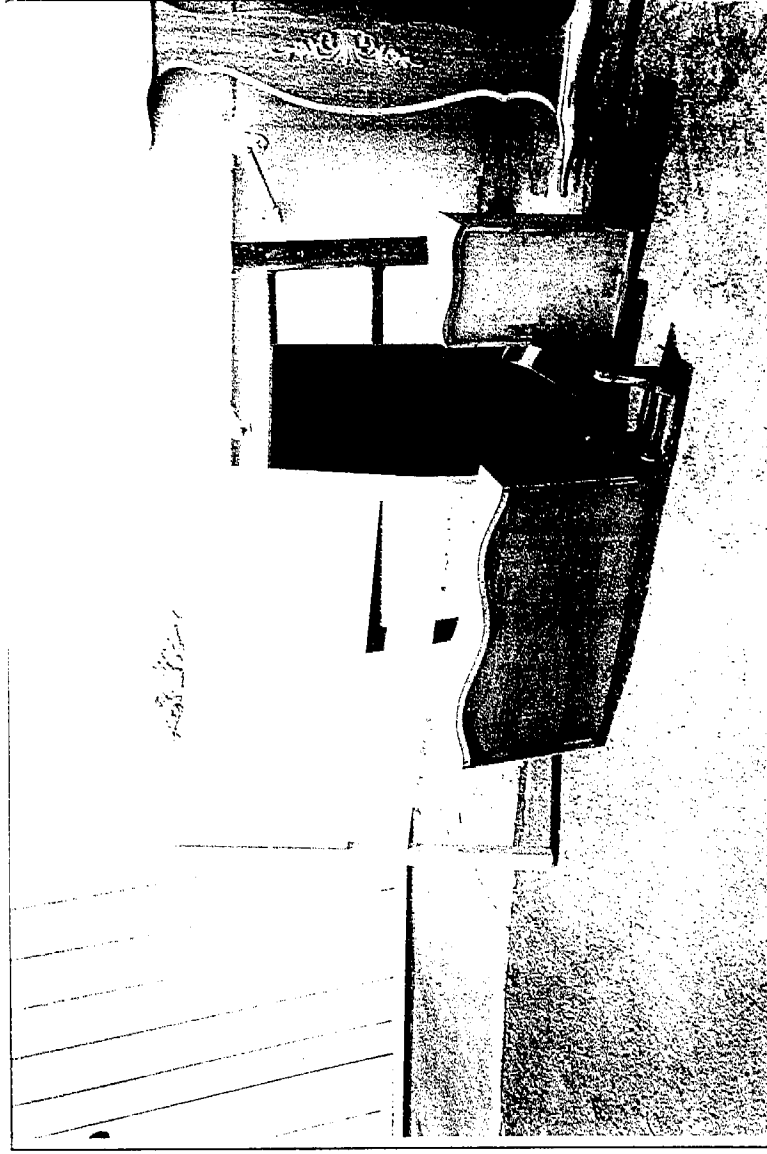


Figure 3-76 Items Stripped with B25 Stripper at Sunset Strip

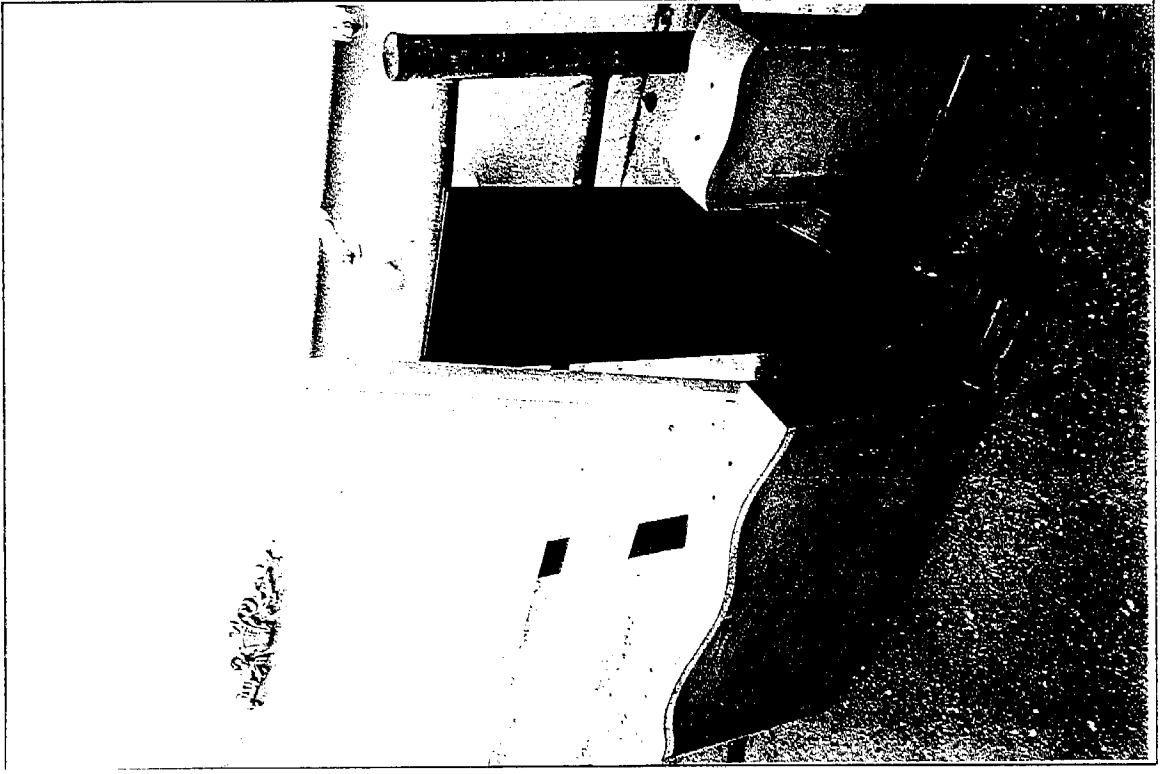


Figure 3-77 Items Stripped with  
CAE2 Stripper at Sunset Strip

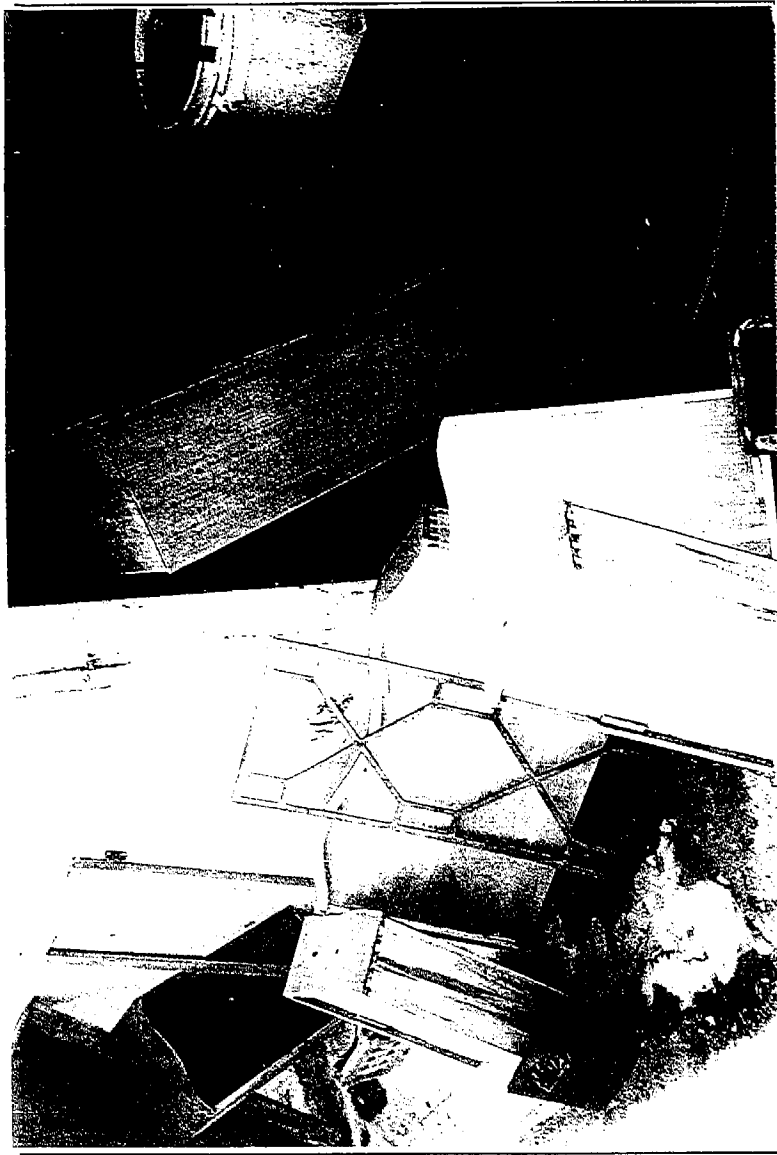


Figure 3-78 Items Stripped with  
CAE2 Stripper at Sunset Strip



Figure 3-80 Items Stripped with CAE3 Stripper at Sunset Strip

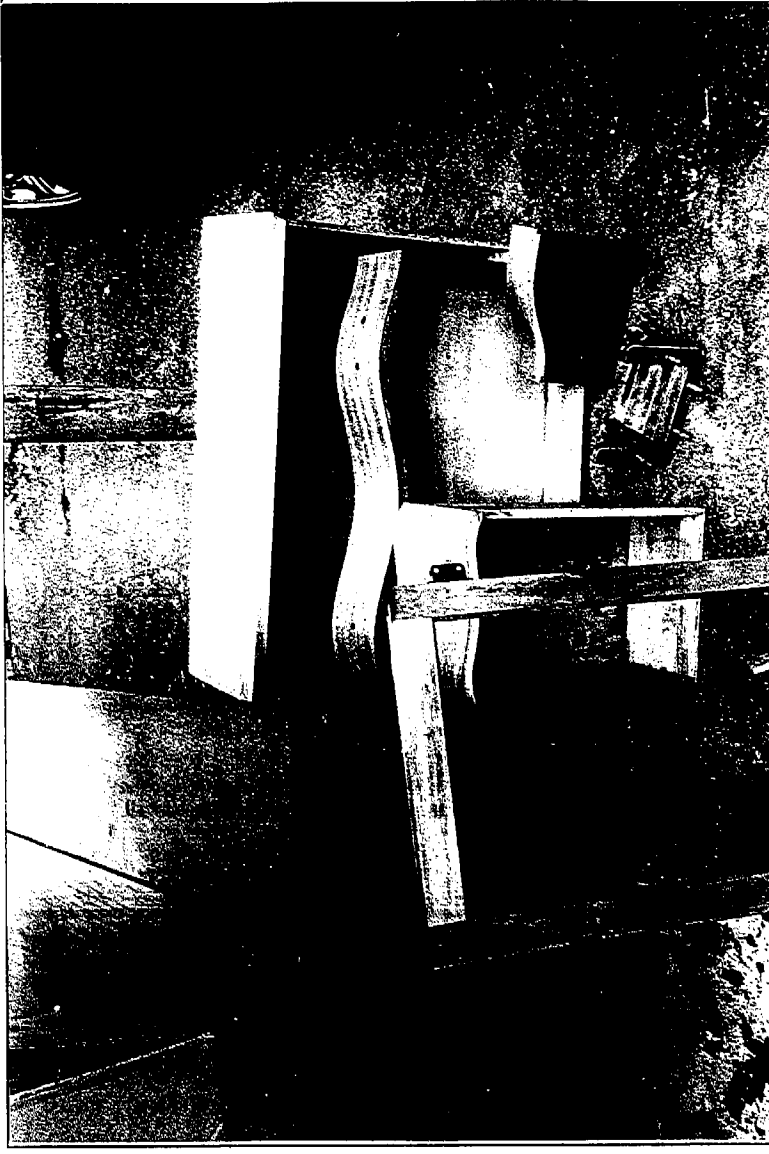


Figure 3-79 Items Stripped with CAE3 Stripper at Sunset Strip

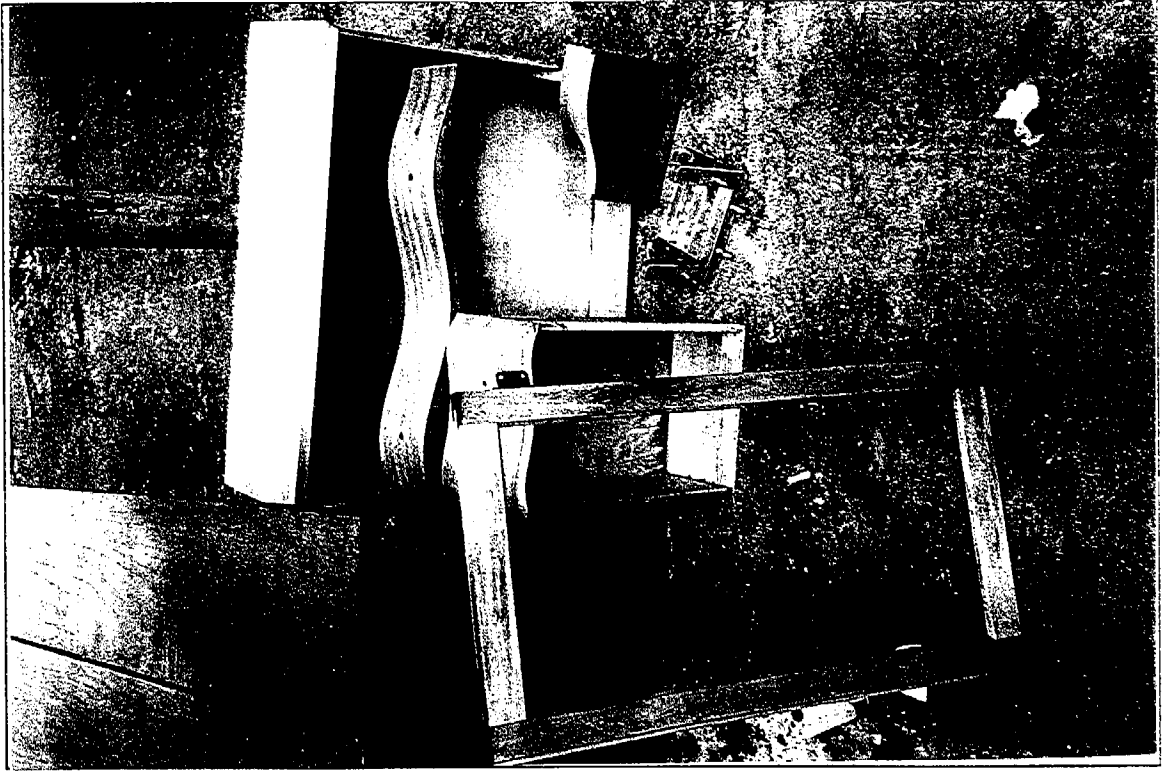


Figure 3-81: Stripping Door at  
Stripper Herk



Figure 3-82: Stripper Acting on Door at Stripper Herk

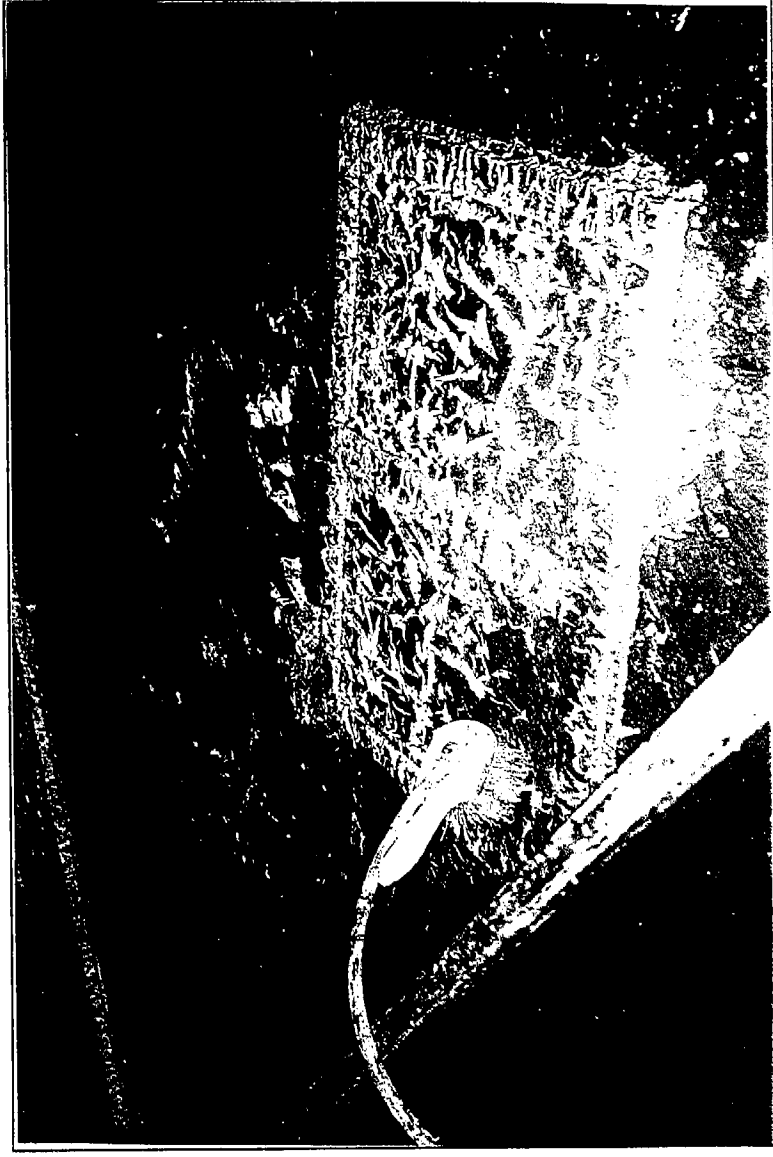


Figure 3-83: Items Drying at Stripper Herk

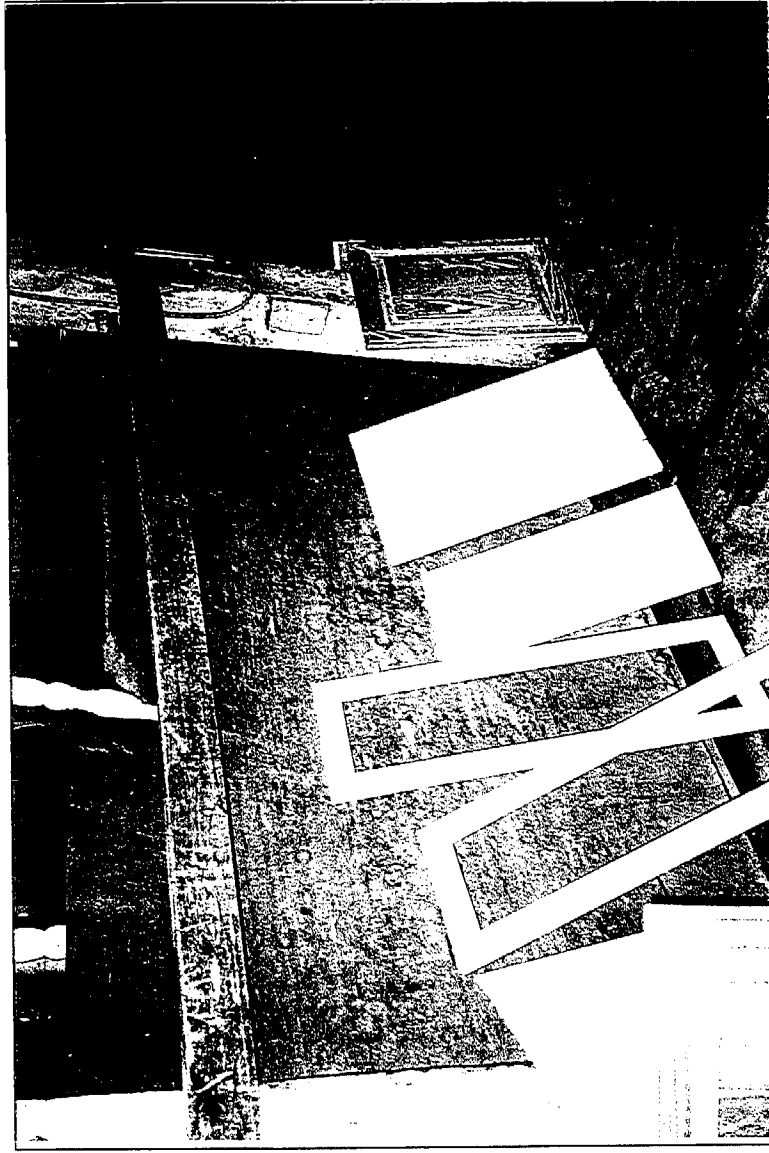
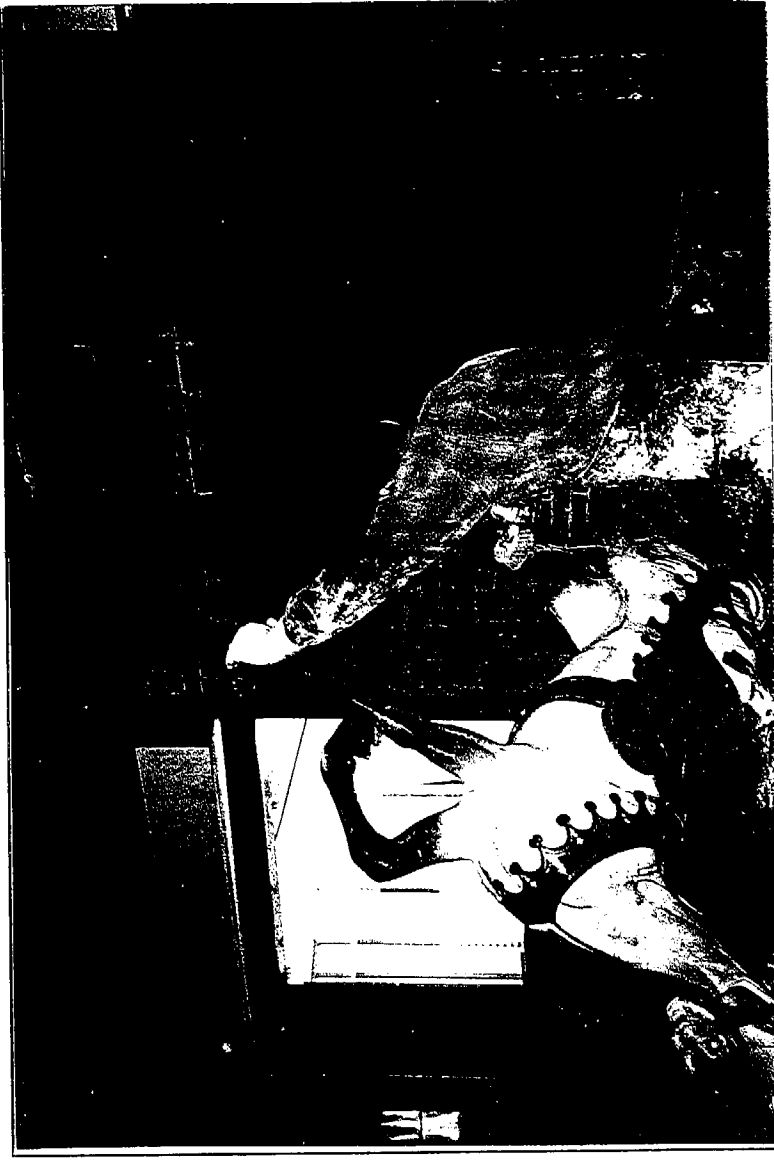


Figure 3-84: Stripping Carousel Horse at  
L.A. Stripping & Finishing Center



Figure 3-85: Applying Stripper to Carousel Horse at L.A. Stripping & Finishing Center





#### IV. VENTILATION SYSTEM TESTING

As discussed earlier, IRTA conducted a project sponsored by NIOSH that involved designing and building higher air flow ventilation systems that might be effective in reducing worker exposure in furniture stripping operations. A new OSHA regulation requires workers in stripping facilities to meet a 25 ppm exposure level. During the NIOSH project, the worker exposure at three stripping facilities with improved ventilation systems was tested. Use of higher air flow ventilation systems can be effective in reducing the MICR at the nearest offsite receptor as well as reducing the worker exposure. Two of the higher air flow ventilation systems designed and installed at Strip Joint and Sunset Strip were tested as part of this project to determine whether and how much they could reduce the MICR at the nearest offsite receptor. The baseline and best alternative strippers were also tested with the higher air flow ventilation systems. SCAQMD staff members performed the source testing at the two facilities. The ventilation system testing is described in this section.

##### VENTILATION SYSTEM TESTING AT STRIP JOINT

In the ventilation system evaluation, two different strippers were tested at Strip Joint. They included the Benco B7 stripper, the baseline stripper discussed earlier and the Benco B25 stripper, the low-METH stripper containing NMP that performed best during the alternative stripper tests. The B7 stripper contains about 82% METH and the B25 contains much less METH, at between 40 and 50%.

The old ventilation system on the flow tray at Strip Joint consisted of six inch PVC pipe wrapped around the two sides and the back side of the tank. There were seven holes which were each two inches in diameter cut through to the inner, upper sides of the stripping tank. Flexible duct connected the system to a small fan and was exhausted out the roof. The old ventilation system had been replaced with a new higher air flow ventilation system as part of the NIOSH project. The old ventilation system had been discarded so it was not available for testing. During an earlier project with SCAQMD and NIOSH, however, the SCAQMD source testing team did measure emissions and the efficiency of the old ventilation system. These data are presented here with the new test data.

The new ventilation system, supplied by Benco Sales, consisted of two hoods, one on the flow tray and one on the rinsing tank. The flow tray is a five foot by ten foot tank, 37 inches high. The depth of the tank slopes from nine inches to 13 inches at the drain. A hood that is nine feet eight inches long, 23 inches high ranging in depth from 7.5 to 17 inches, is attached to the back of the tank. There is a baffle around the tank and hood that encloses the tank positioned 56 inches above the top edge of the tank. The hood contains three slots that were nine feet long and one inch wide. The hood is connected to a 12.5 inch diameter duct on the left side. The duct was connected to a centrifugal blower which is in turn connected to 10 inch duct that is routed through the ceiling of the facility. Figure 4-1 shows a picture of the new ventilation system.

The hood on the water wash booth is similar to the hood on the flow tray. The rinse tank is four by eight feet and 37 inches high. The depth of the tank slopes from eight to 11 inches. A hood that is seven feet long, 23 inches high and 7.5 to 17 inches deep is attached to the back of the tank. The tank is surrounded on three sides by walls. Again, the hood contains three slots. The hood is connected to a duct on the right side; the duct is connected to a blower which is in turn connected to duct that is routed through the roof. Figure 4-2 shows the ventilation system on the water wash booth.

Figure 4-1: New High Air Flow Ventilation System on Flow Tray at Strip Joint

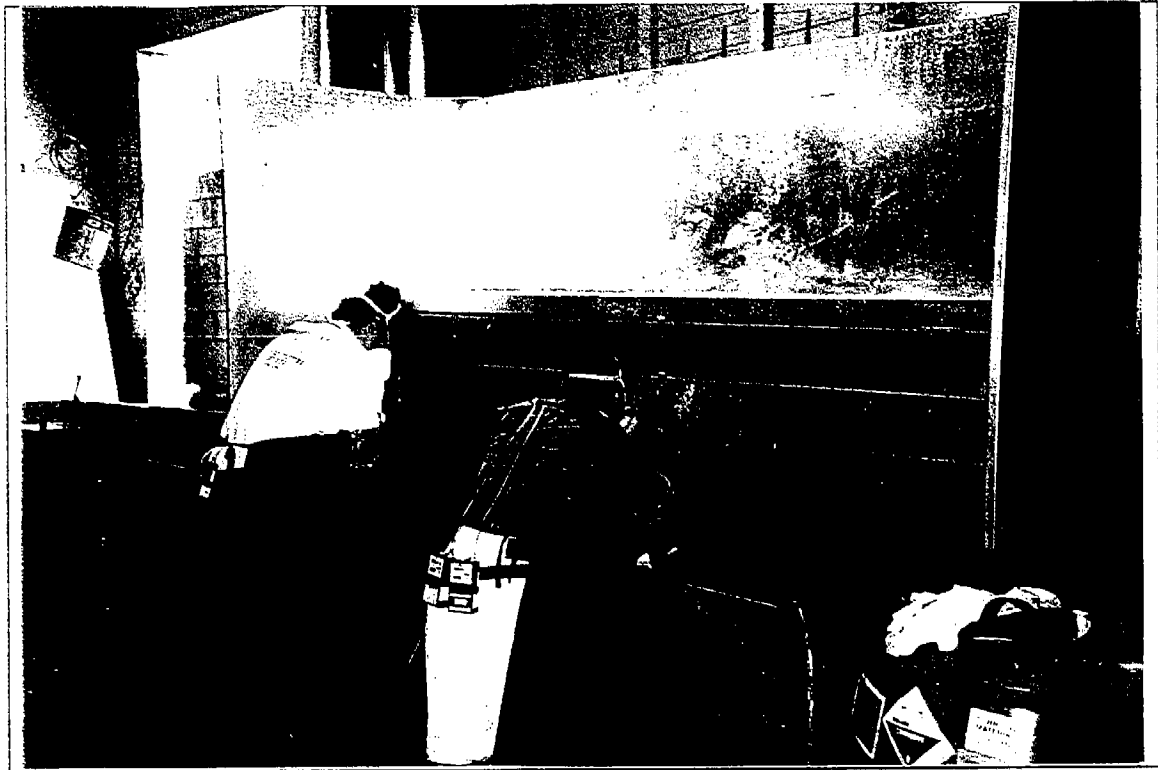
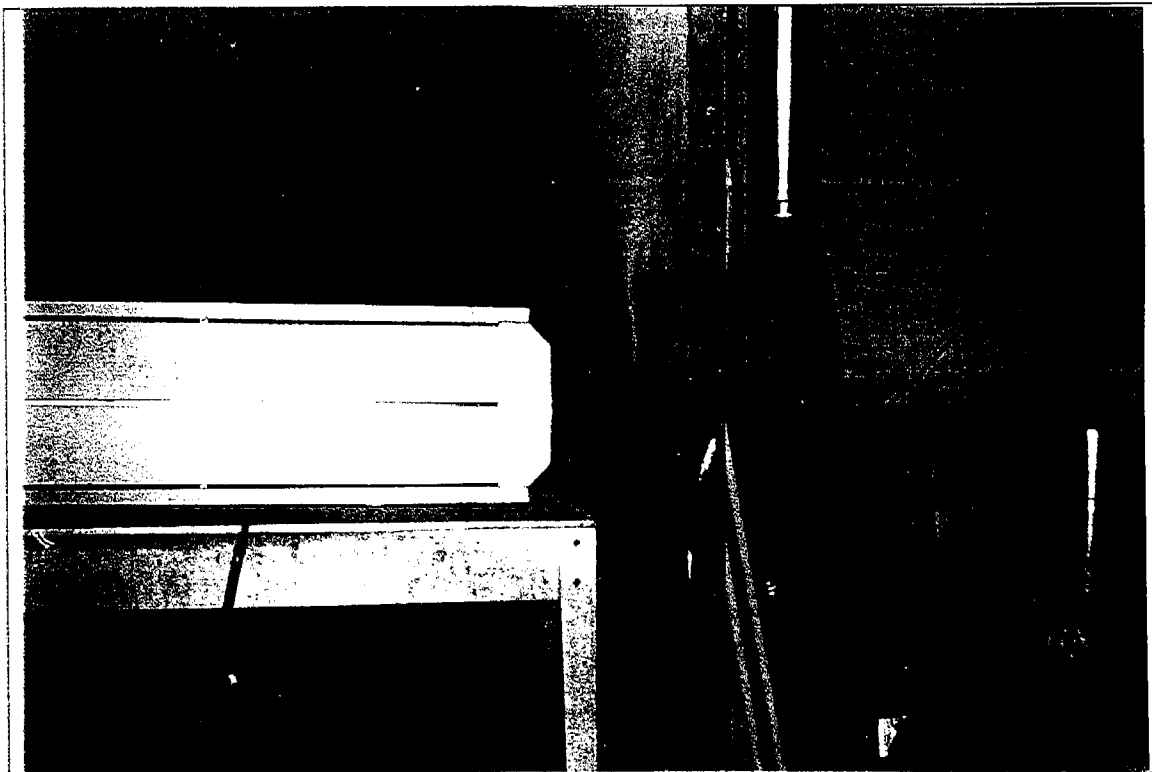


Figure 4-2: Ventilation System on Water Wash Booth at Strip Joint



During the testing in the earlier project, NIOSH measurements indicated that the old flow tray ventilation system exhausted 126 cfm. At the same time, SCAQMD measured the flow rate at 114 cfm. The old ventilation system had been removed and replaced with the new higher air flow ventilation system during the earlier study so no air flow measurements on the old system were made.

In the earlier project, NIOSH measured the air flow of the new ventilation system on the flow tray at 1400 cfm; SCAQMD found a flow rate of 1596 cfm. According to the NIOSH measurements, the rinsing hood exhausted approximately 1900 cfm; SCAQMD measured a flow rate of 1650 cfm for the rinsing tank. The NIOSH and SCAQMD measurements for the flow tray ventilation systems agree fairly well. During the current CARB project, the SCAQMD measured the flow rate for the ventilation system on the flow tray at 1570 cfm which agrees well with their earlier measurement of 1596 cfm. In the current study, SCAQMD measured the flow rate on the rinse hood at 1470 cfm which is somewhat lower than the earlier measurement of 1650 cfm. The difference may be due to deterioration over time.

There were four sampling periods at the Strip Joint. During those periods, SCAQMD staff performed source testing at the stacks. The four sessions were conducted under the following conditions:

- Use of baseline stripper (B7) with the new ventilation system
- Use of low-METH B25 stripper with the new ventilation system
- Use of low-METH B25 stripper with the new ventilation system
- Use of low-METH B25 stripper with the new ventilation system

SCAQMD wanted to conduct triplicate test runs under one test condition to evaluate the precision of the testing by the EPA Data Quality Objective from its "Guidelines for Determining Capture Efficiency." Thus three of the sessions were the same.

#### Source Testing Procedure and Results

The source testing was conducted during normal stripping operations. The facility workers collected furniture in advance for the four runs that was similar so that one piece of each type could be stripped during each run. The coating types varied and included lacquer, stain and pigmented paint.

One worker performed the stripping and the rinsing. The pieces were stripped in the flow tray and the flow tray pump continued to pump stripper when the worker transferred the piece to the water wash booth for rinsing. When the rinsing was completed, the worker transferred the piece to the drying area.

The SCAQMD source testing was performed for the flow tray and the water wash booth. During the four sessions, there were eight sampling runs--four for the flow tray and four for the water wash booth. The four sampling runs were 65, 60, 55.5 and 60 minutes respectively in duration. The five gallon bucket used to dispense the stripper was weighed before and after each run. The SCAQMD staff sampled the stripper before and after the run to determine the METH content and the solids content. During each run, the capture efficiency was determined by measuring the mass of stripping solution lost to evaporation and measuring the mass of METH that passed through the collection vent to the atmosphere. The ratio of the collected METH to the total emissions gives the capture efficiency.

In the earlier NIOSH/SCAQMD project, the SCAQMD source testing staff tested both the old ventilation system capture efficiency and the new higher air flow ventilation system capture efficiency. The SCAQMD source testing results indicated that 6.7 pounds per hour of METH was captured by the old ventilation system on the flow tray when the B7 baseline stripper was used. Total emissions were 31.2 pounds per hour so the emissions routed through the ventilation system amounted to only about 22% of the total emissions. The source testing indicated that the emissions routed through the new ventilation system on the flow tray and the rinse area vent were 12.6 and 2.7 pounds per hour respectively when the B7 baseline stripper was used. These emissions represented about 64% of total emissions.

In the current study, the source testing with the B7 Baseline stripper used in the new ventilation system showed similar results. The total METH emissions amounted to 18.5 pounds per hour. The flow tray vent captured 8.7 pounds of METH per hour and the rinse area vent captured 2.7 pounds per hour; the total captured METH emissions were 11.5 pounds per hour. This resulted in an overall capture efficiency of 62.3%.

The source test results for the B25 low-METH stripper showed a somewhat higher capture efficiency. In this case, the SCAQMD performed triplicate runs and the results from the three runs were averaged. Total average METH emissions were 12.4 pounds per hour. Flow tray average vent emissions were 7.3 pounds per hour and rinse area average vent emissions were 1.2 pounds per hour. The average capture efficiency was 69.6% for the low-METH stripper.

The results of the source testing for the earlier NIOSH project (see references) and the current project are summarized in Table 4-1.

**Table 4-1**  
**Summary of Emissions and Capture Efficiency at Strip Joint**

Project/ Run Description	Stripper Emissions (lb/hr)	METH Emissions (lb/hr)	Flow Tray Emissions (lb/hr)	Rinse Area Emissions (lb/hr)	Capture Efficiency (%)
NIOSH/old ventilation/B7	33.6	31.2	6.7	-	21.5
NIOSH/new ventilation/B7	24.3	24.0	12.6	2.7	64.0
CARB/new ventilation/B7	21.2	18.5	8.7	2.7	62.3
CARB/new ventilation/B25	15.0	12.4	7.3	1.2	69.6

Comparing the capture efficiency of the old ventilation system with the B7 stripper with that of the efficiency of the new ventilation system with B7 demonstrates a significant advantage for the new ventilation system. The capture efficiency of the old ventilation system was 21.5%; the new ventilation system increased the efficiency to 62 to 64%.

The source test results showed that total stripper emissions were about 21 pounds per hour for the B7 with the new ventilation system and that emissions were lower, 15 pounds per hour, for the B25 with the new ventilation system. This was expected

because the B25 stripper has a much lower vapor pressure than the B7. The results also showed that the emissions routed through the new ventilation system on the flow tray and rinse area vents were 7.3 and 1.2 pounds per hour respectively when the B25 low-METH stripper was used. Emissions from the flow tray and rinse area vents for the B7 were slightly higher, at 8.7 and 2.7 pounds per hour. This can be explained by the fact that the B25 contained less METH than the B7 and that it seemed to maintain its consistency during the testing.

The capture efficiency of the B7 with use of the new ventilation system was 62%. This is lower than the capture efficiency, about 70%, of the B25 with use of the new ventilation system. Although this difference might, at first, be considered significant, IRTA has concluded that it is not. The difference can be attributed to other factors like size of furniture pieces, temperature, or humidity. The results from Sunset Strip presented later did not show a difference in the capture efficiency of the two strippers.

The MICR at the nearest offsite receptor is reduced when the METH emissions are lower and when they are routed through a ventilation system. This occurs because the METH emissions due to stripping operations are captured and pulled out the ventilation stacks for dispersion. The SCAQMD source test results at the Strip Joint indicate that both the low-METH stripper and the new ventilation system would be effective in reducing the MICR at the nearest offsite receptor. The MICR at the nearest offsite receptor reduction that can be achieved is estimated in Section V.

#### VENTILATION SYSTEM TESTING AT SUNSET STRIP

Sunset Strip had installed a new higher air flow ventilation system during the earlier NIOSH project. Although the company no longer used their old flow tray for stripping, they had kept it. For the source testing, Sunset Strip was able to reassemble their old ventilation system. The old ventilation system at Sunset Strip was similar to the old ventilation system at the Strip Joint. It consisted of a flow tray containing four one-inch vents in the sides. The vents are connected to a 1/2 hp blower and vented through a 4-inch PVC pipe. SCAQMD measurements indicated a flow rate of 235 cfm. The rinse booth did not have a ventilation system. Figure 4-3 shows a picture of the old ventilation system at Sunset Strip.

The new ventilation system at the Strip Joint was designed with cost in mind. Furniture stripping firms are very small and some short cuts were taken in the design to determine the effectiveness of a low cost ventilation system. The new ventilation system at Sunset Strip was designed without taking cost into account. It was built by Benco Sales and NIOSH staff participated heavily in the design. It consists of two exhaust systems, one on the flow tray which includes an air shower to supply fresh air and one on the water wash booth. On the flow tray, a two-sided slot design was used for the hood. In addition, flexible plastic sheet was used to enclose the tank leaving an open area in the front of the tank for the worker. The hood is connected to 16 inch diameter duct on the left side. The duct has a long radius 90 degree el and it is routed through the ceiling and connected on the roof through a second long radius el to a centrifugal blower. The blower is connected to a 12 inch diameter duct which is routed directly upward. Figure 4-4 shows a picture of the new flow tray ventilation system at Sunset Strip.

The air shower is positioned over the front part of the stripping tank to provide clean make up air to the work station. It is composed of pegboard and a plenum which is attached through a transition to an 8-inch diameter duct which makes a 90 degree turn and is routed through the ceiling where it is attached to a centrifugal blower. The duct for the fan extends to the edge of the roof. It has a 90 degree turn downward so it draws air

from the side of the building. In the earlier study, NIOSH measurements indicated that the stripping hood exhausted 3100 cfm. In the current study, the SCAQMD measured the flow rate at 2980 for the flow tray. Figure 4-5 shows a picture of the air shower above the flow tray.

Figure 4-3: Old Ventilation System  
at Sunset Strip

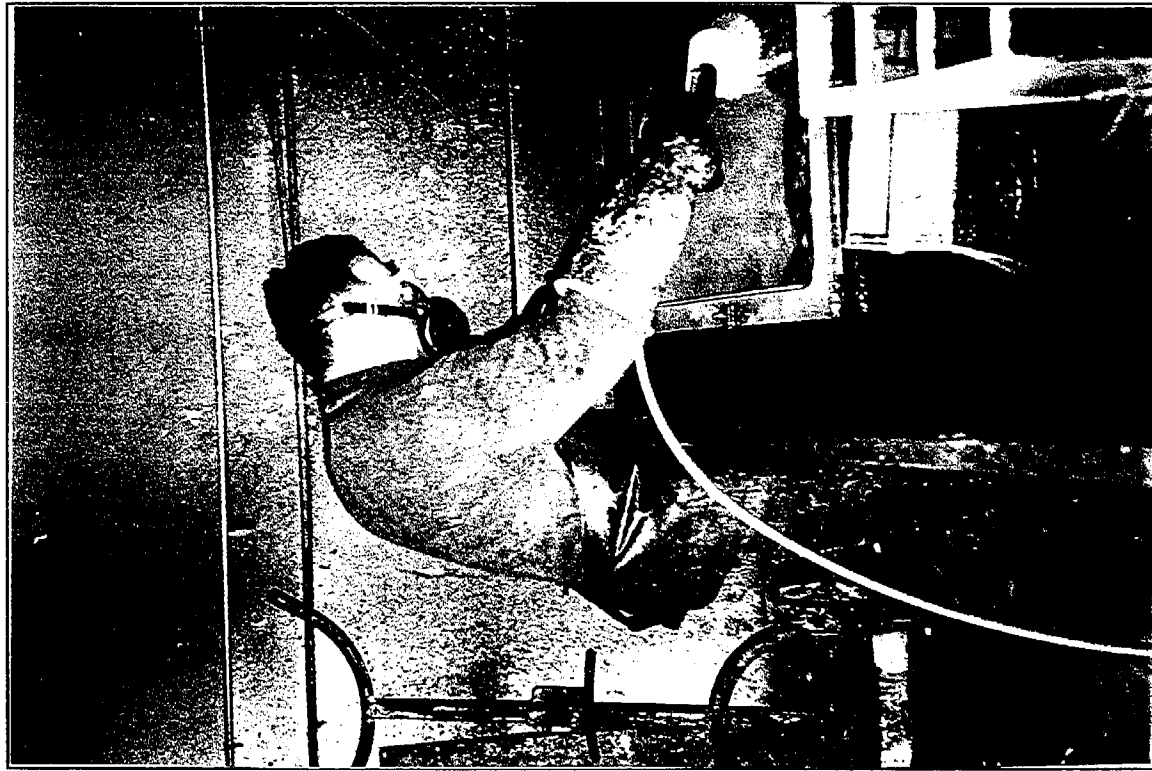


Figure 4-4: New High Air Flow Ventilation System on  
Flow Tray at Sunset Strip



Figure 4-5: Air Shower on Flow Tray at Sunset Strip



The water wash booth is an enclosed area with a platform made of pegboard. The sides and top are made of plywood. Plastic sheet is also attached to limit the size of the front opening. A plenum is attached to the back wall. It is connected through a transition to 12 inch diameter duct at the top. The duct is routed through the ceiling and connected to a centrifugal blower. This blower, in turn, is connected to a duct that goes directly up. The rinse booth does not include an air shower. In the current study, SCAQMD measured the air flow in the rinse booth at 3230 cfm. Figure 4-6 shows a picture of the new water wash booth ventilation system.

#### Source Testing Protocol and Results

The source testing at Sunset Strip was similar to the source testing at the Strip Joint. At Sunset Strip, there were four runs to determine the capture efficiency. The runs included:

- Baseline B7 stripper with old ventilation system
- Low-METH B25 stripper with old ventilation system
- Baseline B7 stripper with new ventilation system
- Low-METH B25 stripper with new ventilation system

As before, the facility collected similar pieces of furniture for testing during the four runs. Each of the runs lasted approximately an hour. The first, second and fourth runs lasted exactly 60 minutes and the third run--the run with the baseline B7 stripper with the new ventilation system--lasted 57.5 minutes. As was the case at Strip Joint, a five-gallon bucket was used to apply the stripper and it was weighed before and after the test run. The capture efficiency was determined as before.



Figure 4-6: Ventilation System on Water Wash Booth at Sunset Strip



For the first run, the B7 baseline stripper with the old ventilation system, the total METH emissions were 19.2 pounds per hour. The amount of METH captured in the flow tray vent was 7.6 pounds per hour. The old system did not include ventilation on the rinse booth. The total capture efficiency for this run was 39.8%.

For the second run, the B25 low-METH stripper with the old ventilation system, the total METH emissions amounted to 13.0 pounds per hour. The amount of METH captured in the flow tray was 5.4 pounds per hour which leads to a capture efficiency of 41.6%.

For the third run, the B7 baseline stripper with the new high air flow ventilation system, the total METH emissions were 21.2 pounds per hour. The METH captured in the flow tray vent and the rinse booth amounted to 17.3 and 1.7 pounds per hour respectively. The total capture efficiency for this run was 89.7%.

For the fourth run, the B25 low-METH stripper with the new ventilation system, the total METH emissions were 16.3 pounds per hour. The METH captured in the flow tray and the rinse booth was 13.5 and 1.2 pounds per hour respectively. The capture efficiency for this run was 90.0%.

The information for the four runs at Sunset Strip is summarized in Table 4-2 below.

**Table 4-2**  
**Summary of Emissions and Capture Efficiency at Sunset Strip**

Run Description	Stripper Emissions (lb/hr)	METH Emissions (lb/hr)	Flow Tray Emissions (lb/hr)	Rinse Area Emissions (lb/hr)	Capture Efficiency (%)
old ventilation/ B7	20.4	19.2	7.6		39.8
old ventilation/ B25	13.5	13.0	5.4		41.6
new ventilation/ B7	22.0	21.2	17.3	1.7	89.7
new ventilation/ B25	16.0	16.3	13.5	1.2	90.0

The data in Table 4-2 show a very high capture efficiency for the new higher air flow ventilation system. The data also show that use of the low-METH stripper reduces total emissions of METH as expected. Comparing the results of the first run with the second run and the third run with the fourth run, the use of the low-METH lower vapor pressure stripper results in lower total emissions of stripper. Note that in this case, there is no significant difference in the capture efficiency of the new ventilation system with B7 and B25.

#### DISCUSSION OF MEASUREMENT RESULTS

The source tests performed by the SCAQMD at Strip Joint and Sunset Strip demonstrate that the higher air flow ventilation systems were effective in routing a greater portion of the METH through the hoods. The lower cost 1500 cfm system at Strip Joint was able to capture 60 to 70% of the METH depending on the stripping formulation that was used. The higher cost 3000 cfm system at Sunset Strip performed very well and was able to capture about 90% of the METH emitted from the facility. The more METH emissions routed through the ventilation system, the lower the exposure to METH emissions at the MICR location 25 meters from the stripping emissions source.

The testing at Strip Joint showed that emissions of METH could be reduced significantly through use of one of the alternative low-METH stripping formulations. Total METH emissions with the baseline stripper amounted to 18.5 pounds per hour. Total METH emissions with the alternative low-METH stripper were 12.4 pounds per hour, a reduction of one-third. This is expected because of the lower METH content of the stripper. In the earlier NIOSH project, the lower-METH strippers lost their METH, the high vapor pressure component, selectively. In this project, the stripper was formulated well and there was no selective loss of METH.

The testing at Sunset Strip also indicated that total METH emissions were lower when the alternative stripper was used. With the new high air flow ventilation system, total METH emissions with the baseline stripper were 21.2 pounds per hour. Total METH emissions with the alternative stripper were 16.3 pounds per hour, a reduction of 23%.

The results of the ventilation system tests also demonstrate that the use of a higher air flow ventilation system can capture more of the METH emissions from the stripping

operations. At the Strip Joint, the 1500 cfm ventilation system capture between 62 and 70% of the METH emissions. At Sunset Strip, the 3000 cfm system captured about 90% of the METH emissions.

## **V. IMPLICATIONS OF ADOPTING IMPROVED VENTILATION SYSTEMS AND LOW-METH CONTENT STRIPPERS**

If furniture stripping facilities in the state were to purchase and use higher air flow ventilation systems and low-METH content strippers, the MICR at the nearest offsite receptor could be reduced. The source test results described in the last section demonstrated the reduction in emissions that could be achieved through use of lower METH content strippers. IRTA used earlier SCAQMD modeling calculations to analyze the risk implications of the emission reductions and the capture of emissions from stripping operations. The SCAQMD is currently performing additional modeling calculations that may more accurately characterize the risk reduction.

If furniture stripping facilities were required through a regulation to adopt higher air flow ventilation systems and use low METH content strippers, there would be costs. IRTA performed a cost analysis for typical strippers to determine how the cost of the two options would affect stripping facilities in the state.

This section discusses the METH emissions from furniture stripping operations. It focuses on developing a METH emissions factor that can be used to determine the likely emissions from a typical facility. It uses the emissions factor to determine the reduction of the MICR at the nearest offsite receptor that can be achieved through adoption of the two METH emissions exposure reduction methods, use of an alternative low-METH content stripper and use of a higher air flow ventilation system. Finally, it analyzes the costs to a typical stripping firm for adopting these emission reduction measures.

### **EMISSIONS FACTOR**

In the furniture stripping operation, there are three process areas where METH emissions occur. First, METH is emitted during the stripping process at the flow tray, during the rinse operation and during the furniture drying process. Second, depending on the operation, a small amount of METH may enter the water during the rinse process and be discharged to the sewer. Third, some of the METH is shipped off-site as hazardous waste.

The amount of METH lost to the water during the rinse operation is negligible. Some of the METH still entrained in the furniture when the furniture is being rinsed will enter the rinse water. In many stripping operations, the rinse water is continuously recycled. Because METH has a very high vapor pressure, most of the METH evaporates from the water during rinsing and therefore a very small amount may remain in the water. Only in the case of strip shops that discharge the rinse water to the sewer would a small amount of METH be lost through the water. For purposes of analysis, this small amount of METH retained in the water will be considered negligible and will be ignored.

IRTA gathered information from two waste haulers on the amount of METH in the hazardous waste shipped off-site by furniture strippers. One hauler hauls waste from 15 or 20 stripping shops, half of them in California. He indicates that the amount of METH remaining in the sludge he picks up ranges from 0 to 12%. A typical stripping shop generates about one drum of waste for every 10 drums of stripper purchased. A large stripping shop may purchase 1,000 gallons or about 18 drums of stripper annually. The shop generates about 1.8 drums of waste. Assuming a METH content of 6%, the METH in the waste accounts for 0.6% of the stripper purchased. Assuming a METH content of 80% for the stripper that is purchased, the METH in the waste accounts for 0.8% of the METH purchases.

Most stripping firms generate waste with a very low METH content. They use the stripper efficiently which means they use it until the liquid is exhausted. This means that most stripping firms generate waste with very little METH in it.

Some stripping firms that use the stripper less efficiently generate waste containing larger amounts of METH. Another hauler picks up waste from a furniture stripper in the Southern California area. He indicates that the METH content of the waste is about 30%. This stripper purchases about 1,000 gallons of stripper annually and generates about 5 drums of waste. The amount of METH in the waste, in this case, is 8.3% of the stripper purchased. Assuming the METH content of the stripper is 80%, the METH in the waste is 10.4% of the METH purchases.

For purposes of reporting, air districts in California commonly allow companies to subtract some amount of the chemical from their purchases when they estimate emissions to account for waste. Often the air districts allow companies to assume a default value of 50% of what is manifested as waste. In other words, if the company cannot provide waste profiles listing an annual amount of METH shipped off-site, they can deduct 50% of the waste from the emissions of the chemical. An average number taking into account the lower METH content wastes, the higher METH content waste and the air district default value is 5% of the METH purchases. This is the default value that should be used for this industry.

As an example, consider a stripping shop that purchases 10 drums per year of stripper containing 80% METH. This amounts to 8 drums annually of METH. The default value for this shop for the METH in the waste would be 22 gallons or about 240 pounds. The remainder of the METH, 418 gallons or 4,598 pounds, is emitted. As another example, consider a shop that uses a low-METH content stripper containing 50% METH. This shop also purchases 10 drums per year of stripper. The amount of METH the shop purchases each year is only 5 drums. Using the waste default value of 5%, the METH waste would amount to about 14 gallons or 151 pounds annually. The balance of the METH, 261 gallons or 2,871 pounds, is emitted.

From the analysis performed and the data collected during this project, IRTA recommends that a default value of 5% by volume of the METH purchases be used to account for the METH lost in the waste. The amount of METH emitted can be determined based on the stripper purchases and the percent of METH in the stripper. The calculation is shown below.

$$\begin{aligned}\text{METHE} &= 11 \times 0.95 \times \text{STRIPPERPUR} \times \text{METH\%} \\ &= 10.45 \times \text{STRIPPERPUR} \times \text{METH\%}\end{aligned}$$

where METHE is the annual METH emissions in pounds  
10.45 is a factor that represents the density of METH (11 pounds per gallon) times 0.95, the % of METH emitted  
STRIPPERPUR is the volume of stripper purchased annually in gallons  
METH% is the fraction of METH in the stripper

#### MICR REDUCTION AT THE NEAREST OFFSITE RECEPTOR

The two options for reducing the exposure to METH emissions from furniture stripping that were analyzed and tested during this project are use of alternative low-METH strippers and use of higher air flow ventilation systems. The capability of these two options in reducing MICR at the nearest offsite receptor is analyzed in this section.

### Need for Cancer Risk Reduction

The SCAQMD has two regulations in place currently that focus on risk reduction. SCAQMD Rule 1401 regulates new, modified and relocated sources of Toxic Air Contaminants (TACs). SCAQMD Rule 1402 regulates existing sources of TACs. METH is a listed TAC in both rules. Rule 1402 establishes an MICR threshold of 25 in a million and it requires facilities to reduce the MICR below this level. The rule covers facilities that are currently included in the Hot Spots program. Most of these companies are large and they have already prepared risk assessments.

The District has identified seven industry groups that represent over 7,500 businesses in the Basin that could potentially pose an MICR above the threshold level. One of these industries is "wood stripping/refinishing." Because resources are limited and because many of the facilities that are members of these industries are small companies, the District has decided not to require each of the 7,500 businesses to perform risk assessments. Rather, the District is planning to develop source-specific toxic rules over the next few years to achieve risk reductions. Development of a source-specific rule for the stripping industry is expected to begin in 2002. Although the target MICR is 25 in a million, the source-specific rules will set technology standards rather than particular MICR levels.

The SCAQMD, in their staff report for the Rule 1402 amendments, listed emission thresholds for certain carcinogens that have the potential to pose a high risk. The emission thresholds are conservative estimates of the minimum emissions that could result in an MICR of 100 in a million. For METH, this threshold is 3,300 pounds per year. This translates into 300 gallons of emissions annually. An MICR of 25 in a million, the threshold value targeted in Rule 1402 is 25 in a million. Thus emissions of about 75 gallons of METH annually would trigger concern for the 25 in a million target MICR. As discussed earlier, many of the larger stripping companies with stripping equipment typically use and emit roughly 1,000 gallons of stripper containing about 800 gallons of METH.

### Risk Assessment Procedures

The SCAQMD has developed risk assessment procedures for Rule 1401 for companies to determine whether they can establish new, relocated or modified operations that emit TACs. The procedures involve calculating the MICR which can be compared with the established thresholds. As mentioned earlier, the MICR is defined in SCAQMD Rule 1401 as the estimated probability of a potential maximally exposed individual contracting cancer as a result of exposure to toxic air contaminants over a period of 70 years for residential and 46 years for worker receptor locations. The equation for calculating the MICR is:

$$\text{MICR} = Q \times X/Q \times \text{MET} \times U \times \text{MP} \times \text{LEA}$$

where MICR is the Maximum Individual Cancer Risk which has no units

Q is the maximum emission rate in tons/year(tpy)

X/Q is the dispersion factor in (micrograms/meter cubed)/(tons/year)(( $\mu\text{g}/\text{m}^3$ )/tpy)

MET is the meteorological correction factor

U is the unit risk factor in  $1/(\mu\text{g}/\text{m}^3)$

MP is the multi-pathway factor

LEA is the lifetime exposure adjustment factor

METH is not a multi-pathway toxic and MP is 1 so the equation is:

$$\text{MICR} = Q \times X/Q \times \text{MET} \times U \times \text{LEA}$$

The SCAQMD has developed look-up tables for estimating certain of the factors in the equation shown above. Sources can be characterized on the one hand as a point source, one that releases its emissions through a stack, or on the other hand as a volume source, one that releases emissions from inside a building. Most sources, including furniture strippers, are a combination of point and volume sources. Stack height for point sources is also an important factor. The schedule of operation can also be important in determining the MICR and the SCAQMD has developed tables for facilities operating 12 hours per day or less and facilities operating for more than 12 hours per day. Furniture stripping companies generally operate for 12 hours per day or less. The type and distance from the receptor can influence the MICR. Receptor sites can be residential, worker or sensitive, which includes schools, hospitals and day-care centers. Furniture strippers generally pose a higher MICR at the facility property boundary than some other larger businesses because they are located closer to receptor sites.

The value for  $X/Q$  in the equation above is determined based on the release height, which is influenced by the stack height and the receptor distance. The term MET will vary depending on the location of the facility.  $U$ , the Unit Risk Factor, is fixed for a certain substance. For METH,  $U$  is  $1 \times 10^{-6}/\mu\text{g}/\text{m}^3$  (South Coast Air Quality Management District Staff Report for Rule 1402 - Control of Toxic Air Contaminants from Existing Sources and Rule 1401 - New Source Review of Toxic Air Contaminants, March 17, 2000). LEA is determined based on the characteristics of the nearest receptor site. LEA is 1.0 for a residential receptor and is 0.14 for an off-site worker receptor when the facility operates 24 hours per day and 365 days per year. If the facility operates for less than 24 hours per day, LEA for an off-site worker is 0.66. Using the SCAQMD look-up tables in Appendix J, a value for  $X/Q$  can be obtained. This factor, when multiplied by  $Q$ , can provide an estimate of MICR.

This approach is designed to be very conservative and it is likely that using the screening MICR assessment procedures will overestimate the true MICR. Use of the dispersion model ISCST3 may yield lower MICR values. The SCAQMD plans to develop a more accurate look-up table based on a variety of different ISCST3 model runs for the Strip Joint and Sunset Strip as part of their upcoming rule development process. These look-up tables may be used to estimate the risk reduction that can be achieved through the use of low-METH content stripping formulations, and show the reduction of exposure to METH emissions at the nearest offsite receptors.

During IRTA's previously mentioned NIOSH project (see references), when SCAQMD performed source testing on one of the higher air flow ventilation systems analyzed during the current CARB project, SCAQMD developed a look-up table specifically for Strip Joint. The District made several assumptions about operating times and used the MET data for Redondo Beach. The SCAQMD ran several ISCST3 runs for the facility that varied the percentage of the METH emitted from a volume source or through a stack. The results for  $X/Q$  for Strip Joint are shown in Appendix J. The values in Table 2 were used in the analysis here to estimate the cancer risk reduction at the nearest offsite receptor that can be achieved through use of the higher air flow ventilation systems at Strip Joint and Sunset Strip, as well as the alternative strippers.

In the earlier NIOSH project during the testing at Strip Joint, the SCAQMD source testing results indicated that 21.6% of the emissions were captured when the old ventilation system was used with the baseline stripper. The source testing results in the

current CARB project indicated that the capture efficiency with the new higher air flow ventilation system was 62.2% when the baseline stripper was used.

Using the values in Table 2 in Appendix J for a downwind distance of 25 meters and interpolating between the air flow values, X/Q with the old ventilation system is  $19.02/(\mu\text{g}/\text{m}^3)$  and X/Q with the new higher air flow ventilation system is  $16.64/(\mu\text{g}/\text{m}^3)$ . Assuming the facility uses 1,000 gallons of baseline stripper annually and that the stripper contains 80% METH, the cancer risk posed by the facility to the nearest offsite receptor 25 meters from the source with the old ventilation system is 84 in a million and the MICR posed by the facility with the new ventilation system is 73 in a million. Adopting the higher air flow ventilation system, in this case, leads to a reduction in the MICR of about 13% to the nearest offsite receptor 25 meters from the source.

During this project, the source testing results indicated that the capture efficiency for the old ventilation system at Sunset Strip was 39.8% when the baseline stripper was used. The testing also showed that the capture efficiency for the new higher air flow ventilation system at Sunset Strip was 90.0% when the baseline stripper was used. Assuming the look-up table in Appendix J is appropriate for Sunset Strip, at 25 meters downwind distance, X/Q is  $17.95/(\mu\text{g}/\text{m}^3)$  for the old ventilation system and  $15.02/(\mu\text{g}/\text{m}^3)$  for the new ventilation system. Assuming the facility emits 800 gallons of METH annually, the MICR at the nearest offsite receptor posed by the facility with the old ventilation system is 79 in a million and the MICR at the nearest offsite receptor posed by the facility with the new ventilation system is 66 in a million, a reduction of 17%.

Source tests at Strip Joint, using the B7 baseline stripper with the new ventilation system showed METH emissions were 18.5 pounds per hour. Usage of the B25 stripper with the new ventilation system gave METH emissions of 12.4 pounds per hour. The B25 stripper has a lower vapor pressure and, for this reason, losses of METH are lower. At Strip Joint, use of the alternative stripper with the higher air flow ventilation system reduced METH emissions by 33%. At Sunset Strip, use of the alternative stripper reduced METH emissions by 23% when the new ventilation system was used. When the old ventilation system was used, use of the alternative stripper at Sunset Strip reduced emissions by 32%. Taking the average of the three tests, use of the alternative stripper reduced METH emissions by 29%.

If the Strip Joint used the lower METH content stripper and the 1500 cfm ventilation system, the cancer risk at the nearest offsite receptor 25 meters from the source of METH emissions would be reduced from 73 in a million to 52 in a million. If Sunset Strip used the lower METH content stripper and the 3000 cfm ventilation system, the cancer risk at the nearest offsite receptor 25 meters from the source of METH emissions would be reduced from 66 in a million to 47 in a million.

Table 5-1 summarizes the reductions that can be achieved through use of a higher air flow ventilation system and use of an alternative stripper.



**Table 5-1**  
**Estimates of Cancer Risks Posed by Strip Joint and Sunset Strip under Various**  
**METH Emissions Scenarios<sup>1</sup>**

Measure	Strip Joint (in a million)	Sunset Strip (in a million)	Percent Reduction <sup>2</sup>
Old Ventilation System/ Baseline Stripper	84	79	-
1500 cfm Ventilation System/ Baseline Stripper	73	-	13
3000 cfm Ventilation System/ Baseline Stripper	-	66	17
Old Ventilation System/ Alternative Stripper	60	56	29
1500 cfm Ventilation System/ Alternative Stripper	52	-	38
3000 cfm Ventilation System/ Alternative Stripper	-	47	41

<sup>1</sup> Cancer risks are estimated for a receptor 25 meters from the source of METH emissions

<sup>2</sup> Difference in cancer risk from the old ventilation system/baseline stripper

The values of Table 5-1 indicate that shops that use a higher air flow ventilation system and also adopt the low-METH alternative stripper could reduce their MICR at the nearest offsite receptor by about 40%. None of the MICR values shown in Table 5-1 is low enough to meet the threshold MICR level of 25 in a million specified in SCAQMD Rule 1402. It should be emphasized, however, that the industry-specific rules that the District develops will not be based on a certain MICR level but will be technology-based.

### COST ANALYSIS OF OPTIONS

Furniture stripping facilities are very small businesses with few employees. Stripping facilities with stripping equipment are generally the largest and most sophisticated firms in the industry. A typical stripping company with stripping equipment probably makes an annual profit of about \$30,000. Because profits are so low, it is important to examine and minimize, if possible, the costs these facilities must incur to reduce the MICR at the nearest offsite receptor. IRTA analyzed the costs to stripping facilities for purchasing a new higher air flow ventilation system and for adopting the new low-METH strippers.

#### Strip Joint Ventilation System

The ventilation system that was installed and tested at Strip Joint was a relatively low cost system. This system was designed to determine if a lower cost and less efficient system could reduce exposure to METH emissions and achieve a significant MICR reduction at the nearest offsite receptor.

The capital cost of the 1500 cfm air flow system at Strip Joint is estimated at \$2,500. The delivery and installation cost would range from \$200 to \$2,000, depending on whether installation through walls would be required. For this analysis, it was assumed that a typical facility would pay \$800 for delivery and installation. The analysis assumed the stripping firm would purchase the system on credit and that the system has a useful life of 10 years. This is a conservative value and the system lifetime is likely to be much higher, at least 20 years. Assuming a cost of capital of 10%, the annualized capital/installation cost would amount to \$538.

The system at Strip Joint has a one horsepower motor on the flow tray and one on the rinse booth. Most larger stripping facilities strip two or three days per week for perhaps five or six hours per day. Assuming the stripping facility strips for 16 hours per week, the system electrical requirement is 2,230 kWh annually. Assuming a cost of electricity of 12 cents per kWh, the total annual electrical cost with the higher air flow ventilation system is \$264. The old ventilation system had a three-fourths horsepower motor on the flow tray and no exhaust system on the rinse booth. The electricity cost using the old ventilation system was \$100. It should be noted that electricity costs have recently risen in California but higher electricity costs will not make a significant difference in the conclusions.

The new ventilation system would require more maintenance than the old ventilation system. It was assumed that the old ventilation system would require about \$20 per year in maintenance and the new ventilation system would require about \$200 per year.

Table 5-2 compares the cost of the new and the old ventilation system.

**Table 5-2**  
**Annual Cost Comparison of Strip Joint Old and New Ventilation Systems**  
**(Year 2000 Dollars)**

	Old Ventilation System	New Ventilation
<u>System</u>		
Annualized Equipment Cost	-	\$538
Electricity Cost	\$100	\$268
<u>Maintenance Cost</u>	\$20	\$200
Total Cost	\$120	\$1,006

The values of Table 5-2 show that a typical stripping company would pay about \$900 per year more for a 1500 cfm ventilation system similar to the system tested at Strip Joint. This system, however, did not reduce the estimated risk at the nearest offsite receptor as much as the system installed at Sunset Strip. In addition, during the worker exposure testing in the earlier NIOSH project, the findings indicated that the ventilation system at Strip Joint was not capable of reducing the worker exposure to the OSHA limit of 25 ppm.

#### Sunset Strip Ventilation System

The system tested at Sunset Strip had about twice the air flow of the system tested at Strip Joint. The cost of the 3000 cfm system is estimated by the supplier at \$6,000. Again, assuming that delivery and installation amounts to \$800, that a typical stripping firm finances the purchase, that the cost of capital is 10% and that the system is paid off over a 10 year period, the annualized capital cost is \$1,108.

This higher air flow ventilation system has a one horsepower blower on the air shower, a two horsepower blower on the flow tray and a three-fourths horsepower blower on the rinse booth. Assuming the facility strips 16 hours per week, the electrical load would be 4,181 kWh per year. At a cost of 12 cents per kWh, the total annual electricity cost would be \$502. In this case, it was again assumed that the electricity cost for the old system with a blower only on the flow tray would amount to \$100 per year.

The maintenance cost of the 3000 cfm system would be the same as the maintenance cost of the 1500 cfm system, \$200 per year. The maintenance cost of the old ventilation system was again assumed to be \$20 annually.

As discussed above, the system at Strip Joint was not capable of meeting the OSHA worker exposure level of 25 ppm. In contrast, the higher air flow ventilation system at Sunset Strip was capable of meeting the 25 ppm level. In addition, the system was also capable of meeting the 12.5 ppm action level established by OSHA. Firms that cannot meet the action level must perform regular medical surveillance of their workers and monitoring of the air concentration. The strip shops must perform a medical exam every three years on each employee exposed to METH at a cost that ranges between \$75 and \$400. Assuming a cost of \$150 and assuming that a shop has two employees, the annual cost for medical surveillance would amount to \$50. Monitoring involves testing each worker with badges every six months at a cost of about \$100. The annual cost for monitoring for a facility with two employees would be \$200. The Sunset Strip system, since it meets the OSHA action level, would reduce the medical surveillance and monitoring costs by about \$250 per year.

Table 5-3 shows the annual cost comparison of the old ventilation system and the new higher air flow system at Sunset Strip.

**Table 5-3**  
**Annual Cost Comparison of Sunset Strip Old and New Ventilation Systems**  
**(Year 2000 Dollars)**

	Old Ventilation System	New Ventilation System
Annualized Equipment Cost	-	\$1,108
Electricity Cost	\$100	\$502
Maintenance Cost	\$20	\$200
Medical Surveillance Cost	\$50	-
Monitoring Cost	\$200	-
Total Cost	\$370	\$1,810

The cost to the facility for using the new higher air flow ventilation system is \$1,810 annually. The facility can offset the costs associated with worker exposure and the net cost to the facility is \$1,440 annually. This accounts for about 6% of the profits of a typical facility.

#### Use of Alternative Strippers

The alternative stripper testing was reported in Section III. IRTA conducted additional testing to decide which of the two alternative strippers should be used during the source testing. Another purpose of the stripper tests was to gather information on the comparative cost of using B7, the baseline stripping formulation, and the two best alternative strippers, B25 and CAE2. In these tests, four panels were stripped with the baseline and alternative strippers. The volume of stripper used was recorded and the volume of stripper consumed per square foot of stripper removed was noted. The results of the testing should be used judiciously since the testing was not rigorous. It was performed to gain a qualitative idea of the relative stripper usage.

For the B7 baseline stripper, 0.208 gallons of the stripper per square foot were required. For B25, the value was 0.059 gallons per square foot and for CAE2, the value was 0.078 gallons per square foot. These values differ substantially from the METH usage figures for the baseline and alternative B25 stripper that were noted during the source testing. The source testing figures are more reliable since they were obtained over a longer period of stripping and under more controlled circumstances. The source test data indicated that the METH emissions during use of the B25 stripper were about 29% lower than the

emissions during use of the baseline B7 stripper. The CAE2 stripper was not tested during the source testing. Based on the comparative stripper usage figures, emissions of METH from the use of CAE stripper are likely to be higher than emissions of METH during use of the B25 stripper.

The current price of a 55-gallon drum of B7 is \$429, or about \$7.80 per gallon. The supplier who formulated the B25 and CAE strippers estimates that he would offer the B25 stripper at about 10% more than the B7, or \$8.58 per gallon. The price of the CAE2 would be 5% more than the B7, or \$8.19 per gallon.

A typical larger stripping facility might purchase 1,000 gallons of stripper per year. The annual cost of the B7 stripper would amount to \$7,800. If this stripping facility were to convert to the B25 stripper, less stripper would be required. Using the usage figures above, 71% of the B25, or 710 gallons per year, would be required. On this basis, the cost of the stripper would amount to \$6,092 annually. For CAE2, 725 gallons of the stripper would be required in a year. The cost of this stripper would be \$5,938 annually.

One of the major issues in using the alternative strippers is that the workers in the stripping facilities believed that their performance was not as good as the performance of the baseline stripper. The workers would likely have to expend more labor to use these alternative strippers. Some items might have to be stripped twice and, in some cases, workers might have to increase the use of sanding. It was assumed that the typical facility would strip for 16 hours each week. If the facility converted to one of the alternative strippers, four additional hours of sanding and/or stripping would be required each week. Assuming a labor rate of \$12.75 per hour, the increased cost of labor for using the alternative strippers would amount to \$2,652 per year. One of the other issues that was noted by one of the facilities was that the items did not dry as fast after stripping with the alternative strippers. More time might be required before the facility could paint the items. Although this is a disadvantage, it is not clear how to quantify it.

Table 5-4 presents the comparative costs of using the two alternative strippers under the assumptions described above.

**Table 5-4**  
**Annual Comparative Cost of Baseline and Alternative Strippers for Typical**  
**Stripping Facility**  
**(Year 2000 Dollars)**

	Baseline B7	B25 Alternative	CAE2 Alternative
Annual Stripper Cost	\$7,800	\$6,092	\$5,938
Increased Labor Cost	-	\$2,652	\$2,652
Total Cost	\$7,800	\$8,744	\$8,590

The values of Table 5-4 show that use of the B25 alternative would increase the total stripping costs 12% for the typical facility described here. Use of the CAE2 alternative stripper would increase costs by 10% per year. If the labor costs were increased more than accounted for here, the use of both alternative strippers would carry an increased cost to the facility. In addition, if use of the alternative strippers were actually higher than the source testing indicated, the stripping cost would also increase.

#### FUTURE WORK

As mentioned earlier, the SCAQMD is performing more extensive modeling calculations. The calculations are based on the source testing data developed during this project. The

modeling runs will be performed for one of the meteorological areas in each of the four counties under the SCAQMD jurisdiction. This will allow the generalization of the source testing results to other locations in the Basin. The SCAQMD plans to rely on the modeling results for the regulatory development for this industry in 2002.

The use of one of the alternative low-METH strippers was effective in reducing METH emissions by about 29% during the source tests. This reduction in emissions translates into a commensurate reduction of cancer risk from METH. In the cost analysis section above, however, it was noted that the facilities that tested the alternative strippers did not believe they performed as effectively as the baseline stripper. They suggested that some items might have to be stripped twice and that more stripper overall might be required. It is not clear whether the reduction in emissions and resulting reduction in the MICR from METH achieved over the period of the source test would translate into a similar MICR reduction from METH over the long-term, in actual use. It would be prudent for some shops to conduct additional long-term testing of the alternative low-METH strippers to determine the true effect on emissions.

## VI. SUMMARY AND CONCLUSIONS

METH is employed widely in formulations that are used to strip wood furniture and other wood items. The chemical is a suspect carcinogen and it poses a danger to the workers who use it. METH is classified as a Toxic Air Contaminant in California and it also poses a cancer risk to the residents in the communities surrounding stripping shops. The focus of this project was to identify and test methods of reducing the MICR when METH based strippers are used in California stripping shops. This document provides the results of the project testing.

In a survey conducted in an earlier project, it was estimated that there may be 38 furniture stripping firms that use stripping equipment and large quantities of METH based strippers in the South Coast Basin. There may be as many as 80 such facilities statewide. These facilities emit a significant amount of METH during stripping and the METH emissions pose a risk to people who live and work near the facilities.

Two methods of reducing the MICR posed by furniture strippers were investigated during this project. The stripper used widely by furniture strippers contains about 80% METH. As one of the methods of reducing the exposure to emissions of METH and the associated MICR at the nearest offsite receptor, alternative non-METH and low-METH strippers were formulated and tested in four stripping facilities. Of the eight alternative strippers tested, two of the low-METH content strippers performed the best. Both of these strippers contain less than about 50% METH.

One of these alternative strippers was used during the ventilation system testing. During this testing, it was found that emissions of METH from stripping facilities could be reduced through use of these strippers in place of the baseline stripper. This follows from the fact that the two alternative strippers have a lower METH content and they also have a lower vapor pressure. Use of the alternative strippers could reduce cancer risk from METH posed by furniture stripping facilities. The magnitude of the cancer risk reduction that was achieved through use of the alternative strippers during the source tests is estimated at 29%.

The two best alternative strippers each contain other non-METH components that could be toxic. One of the strippers, the one tested with the higher air flow ventilation systems, contains n-methyl pyrrolidone, a chemical that is a reproductive and developmental toxin. The other stripper contains tert-butyl acetate which has unknown chronic toxicity. The chemical does metabolize to tert-butyl alcohol in the body, however, and tert-butyl alcohol is a carcinogen. Use of these alternative strippers reduces the cancer risk from METH; however, they may increase the cancer and non-cancer risks posed by other components in the stripper.

The second method of reducing exposure to emissions of METH at the MICR location involved testing higher air flow ventilation systems in two facilities. These systems were installed during an earlier IRTA project with NIOSH. Higher air flow ventilation systems can capture more METH for dispersion from stacks on the facility, lowering the MICR at the nearest offsite receptor. The 1500 cfm ventilation system was able to capture between 62 and 70% of the METH depending on the stripping formulation that was used. The 3000 cfm ventilation system was able to capture 90% of the METH that was emitted from stripping operations. The MICR reduction at the nearest offsite receptor that can be achieved through use of the higher air flow ventilation systems is estimated at between 13 and 17%. In an earlier study conducted for NIOSH, worker exposure testing indicated that the 3000 cfm ventilation system could reduce worker

exposure to the action level of 12.5 ppm. In contrast, the 1500 cfm system was not capable of reducing worker exposure to the action level.

The combined reduction to exposure of METH emissions at the nearest offsite receptor due to the use of the higher air flow ventilation systems and the low-METH content strippers is estimated at between 38 and 41%. The analysis conducted here indicates that adoption of the two measures would reduce the MICR at the nearest offsite receptor to about 50 in a million in a typical large stripping shop. This is higher than the threshold MICR value of 25 in a million established in SCAQMD Rule 1402.

A typical stripping shop makes a profit of about \$30,000 annually. A limited cost analysis performed here indicated that the annual cost increase of purchasing a higher air flow ventilation system would range from about \$900 to \$1,400. This represents between 3 and 6% of a typical shop's profits. Use of the alternative low-METH strippers might increase the costs of stripping to a typical shop by an additional \$800 to \$900 annually. The purchase of a higher air flow ventilation system and use of the low-METH stripper might increase costs by 6 to 9% of profits annually.

## VII. REFERENCES

Bixenman, B., "Complying With the OSHA MC Regulation: Getting Under 12.5 ppm," Professional Refinishing, Spring 2000.

Estill, C.F., J.H. Jones and R. Kovein, National Institute for Occupational Safety and Health, "Assisting Furniture Strippers in Reducing the Risk from Methylene Chloride Stripping Formulations at The Strip Joint, Inc., Redondo Beach, California, In-Depth Survey Report.

Estill, C.F., R.J. Kovein, J.H. Jones and A. Morton, National Institute for Occupational Safety and Health, "Assisting Furniture Strippers in Reducing the Risk from Methylene Chloride Stripping Formulations at Los Angeles Stripping and Refinishing Center, Los Angeles, California," In-Depth Survey Report.

Garibay, M., South Coast Air Quality Management District, "Methylene Chloride Emissions From Two Furniture Stripping Operations Using Existing and Reformulated Stripping Solutions and Capture Efficiency of Four Designs of Vapor Collection Systems Vented to the Atmosphere," Source Test Report 98-0004P and 98-0005P, January 22 and 23, 1998.

Garibay, M., South Coast Air Quality Management District, "Methylene Chloride Emissions From Two Furniture Stripping Operations Using Existing and Reformulated Stripping Solutions and Capture Efficiency of Three Designs of Vapor Collection Systems Vented to the Atmosphere," Source Test Report 00-145 and 00-146, September 26 through 28, 2000.

Jones, J.H., C.F. Estill, R.W. Kurimo, R.J. Kovein and D.S. Watkins, National Institute for Occupational Safety and Health, "Assisting Furniture Strippers in Reducing the Risk from Methylene Chloride Stripping Formulations at Sunset Strip, Inc., Huntington Beach, California," In-Depth Survey Report.

South Coast Air Quality Management District, "Risk Assessment Module for Furniture Stripping Operations," undated.

Wolf, K. and M. Morris, Institute for Research and Technical Assistance, "Analysis of Ventilation Systems Used in Furniture Stripping Facilities," prepared for the South Coast Air Quality Management District, September 30, 1997.

Wolf, K. and M. Morris, Institute for Research and Technical Assistance, "Plan for Testing Reformulated Strippers in Furniture Stripping Facilities," prepared for the South Coast Air Quality Management District, September 30, 1997.

Wolf, K. and M. Morris, Institute for Research and Technical Assistance, "Methods for Reducing the Emissions and Risk From Furniture Stripping Facilities," prepared for the South Coast Air Quality Management District, April 30, 1998.

Wolf, K. and M. Morris, Institute for Research and Technical Assistance, "Analysis and Testing of Methods for Reducing the Emissions and Risk From Furniture Stripping Facilities," prepared for the Centers for Disease Control and Prevention, April 2000.



## **Appendix A**

### **MSDS for Baseline Stripper Benco #B7 Industrial Paint Remover**

**MATERIAL SAFETY DATA SHEET**  
Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557  
Emergency Phone: 931-484-9578  
Product Name: **BENCO #B7 INDUSTRIAL PAINT REMOVER**

**1. PRODUCT INFORMATION:**

General or Generic ID: Chlorinated Hydrocarbon, Alcohol Blend  
Trade Name: Benco #B7  
DOT Hazard Classification: Paint Related Material, 8, UN3066, II

**2. HAZARDOUS COMPONENTS:**

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Dichloromethane	25 ppm	25 ppm	70-85
Methanol	200 ppm	200 ppm	8-15
2-Butoxyethanol	50 ppm	25 ppm	1-10
2-Methoxymethylethoxypropanol	25 ppm	25 ppm	1-10
Biodegradable Wetting Agents & Wax	N/A	N/A	1-5

NOTE: Dichloromethane and Methanol are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees. Please call Benco regarding reporting quantities at 800-632-3626.

**3. PHYSICAL DATA:**

Boiling Point:	104F (Initial)	Vapor Pressure:	<300 mm Hg
Vapor Density:	2.93 (Air=1)	Percent Volatile:	>97.0%
Specific Gravity:	1.20	VOC Content:	180 grams/l
Odor: Typical Methylene Chloride			

**4. FIRE AND EXPLOSION HAZARD DATA:**

Flash Point: None to boiling point      Lower Explosive Limit: Unknown  
Extinguishing Media: Water Fog  
Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above ambient. Lower temperatures decrease the difficulty of ignition.  
Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

**5. HEALTH HAZARD DATA:**

**Effects of Overexposure:**

Eyes: Can cause severe irritation and slight corneal injury. Vapors may also irritate eyes. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea, blindness, and even death. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

Inhalation: Major route of potential exposure. Dichloromethane depresses the central nervous system. Concentrations between 900-1,000 ppm may cause dizziness or drunkenness. Nausea, headache, and vomiting can occur at concentrations above 2,000 ppm. At 7,000 ppm, numbness and tingling in arms and legs and rapid heartbeat have occurred. Loss of consciousness and death have occurred at levels above 9,000 ppm, if exposure is prolonged. Carboxyhemoglobin levels can be elevated in persons exposed to Dichloromethane and can cause a substantial stress on the cardiovascular system. This elevation can be additive to the increase caused by smoking and other carbon monoxide sources.

Medical Conditions Aggravated by Exposure: Alcoholism, acute and chronic liver disease, chronic lung disease, or rhythm disorders of the heart.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

**FIRST AID:**

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

NOTE TO PHYSICIAN: This product can induce cardiac sensitization to circulating epinephrine-like compounds. Do not administer adrenaline or similar sympathomimetic drugs for 24 hours following potentially toxic exposures.

**TOXICITY:**

Chronic Toxicity: The findings of chronic toxic effects in laboratory animals may indicate toxicity to humans. Overexposure should be avoided. Failure to do so could result in injury, illness, or even death.

Carcinogenicity: Humans exposed repeatedly to 250 ppm methylene chloride for 7.5 hours per day developed no adverse health effects. Repeated and/or prolonged exposure to high concentrations has induced liver and kidney effects in experimental animals. The National Toxicology Program (NTP) has issued a study which reports that mice exposed for two years by inhalation to methylene chloride vapors at concentrations of 2000 and 4000 ppm developed lung and liver tumors. Rats similarly exposed to 1000, 2000, and 4000 ppm developed benign mammary gland tumors. In two earlier inhalation studies, rats and hamsters exposed to methylene chloride at concentrations from 50-3500 ppm did not develop significant incidences of mammary, lung, or liver tumors. EPA's Science Advisory Board recently concluded that the animal evidence for carcinogenicity is "sufficient" to indicate that methylene chloride has carcinogenic potential. Two epidemiological studies showed no evidence of human carcinogenicity or any other health effects related to methylene chloride exposure. The collective evidence of several animal studies and human experience suggests that there is little carcinogenic risk for humans under controlled conditions of occupational exposure.

The State of California has listed Dichloromethane under Proposition 65 as a chemical known to the State to cause cancer. Epidemiology studies of 751 humans chronically exposed to dichloromethane in the workplace of which 252 were exposed a minimum of 20 years did not demonstrate any increase in deaths caused by cancer or cardiac problems. A second study of 2,227 workers confirmed these results.

## MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #B7 INDUSTRIAL PAINT REMOVER** - Page 2

Reproductive Toxicity: Reproductive toxicity tests have been conducted to evaluate the adverse effects dichloromethane may have on reproduction and offspring of laboratory animals. The results indicate that Dichloromethane does not cause birth defects in laboratory animals.

### 6 REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products: Open flames and welding arcs can cause thermal degradation with the evolution of hydrogen chloride and very small amounts of phosgene and chlorine.

### 7 SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately. Remove to out of doors.

Large Spills: Evacuate area. Contain liquid and transfer to closed metal or polyethylene containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Evaporate small quantities in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

Reportable Quantity (RQ) is 1,250 lb. Notify National Response Center at 800-424-8802 of uncontrolled spills in excess of reportable quantity.

### 8 HANDLING PRECAUTIONS:

Ventilation: Controlling airborne concentrations below the ACGIH TLV exposure guideline is recommended. ACGIH TWA is 50 ppm. OSHA PEL is 25 ppm 8 hour TWA and a STEL of 125 ppm. This rule also establishes an Action Level of 12.5 ppm. Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications. Lethal concentrations may exist in areas with poor ventilation. Contact Benco for further information. Medical monitoring is also required by OSHA for applications that exceed the Action Level of 12.5 ppm.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guideline. If this level is exceeded, use an approved air purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive pressure self-contained breathing apparatus.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

SARA Title III Hazard Categories - Immediate Health, Delayed Health.

### 9 ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits and degreasers, storage tanks, and other confined areas. Do not enter those areas where vapors of this product are suspected unless special breathing apparatus is used and an observer is present for assistance. Do not use this product in a tank or vat where the product level is 12" from the top of the tank. Lethal concentrations of vapors occur in tanks and every effort should be made to keep from breathing below or near the top level of the tank.

Do not pressure product out of container with air. When opening bung, open bung partially and vent any accumulated pressure before removing bung completely. Empty product containers may contain liquid or vapor residues of this product. All precautions suggested in this Data Sheet apply to empty containers also. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repackage this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not use this product in areas where contact of vapors with gas flames or hot electric elements can occur. Please call Benco at 800-632-3626 for advice on proper heating systems. Contact with flames or hot electric elements can produce hydrochloric acid and phosgene fumes which can be fatal.

Overexposure to this product can raise the level of carbon monoxide in the blood causing cardiovascular stress.

Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: June 1, 1999.

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

**Appendix B**  
**MSDS for Alternative NMP Stripper**  
**B23B**

# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 870, Forney, TX 75126

Emergency Phone: 972-552-2917

Product Name: **BENCO #B23B INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Cyclic Amide, Aliphatic Solvent Blend

Trade Name: Benco #B23B

DOT Hazard Classification: Not a DOT Hazardous Material

## 2. HAZARDOUS COMPONENTS:

### INGREDIENT

	PEL(OSHA)	TWA(OSHA)	APPROX%
N-Methyl-2-Pyrrolidone	N/A	N/A	50-65
Aliphatic Petroleum Distillates	100 ppm	100 ppm	15-25
2-Butoxyethanol	50 ppm	25 ppm	5-12
2-Methoxymethylethoxypropanol	25 ppm	25 ppm	5-12
Ethyl-3-Ethoxypropionate	N/A	N/A	5-12

NOTE: None of these ingredients are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees.

## 3. PHYSICAL DATA:

Boiling Point:	329F (Initial)	Vapor Pressure:	<10 mm Hg
Vapor Density:	Greater than Air	Percent Volatile:	>95.0%
Specific Gravity	1.01		
Odor:	Mild solvent odor		

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: >140F Lower Explosive Limit: Unknown

Extinguishing Media: Water Fog

Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above 140F. Lower temperatures decrease the difficulty of ignition.

Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

### Effects of Overexposure:

Eyes: Can cause irritation and slight corneal injury. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a rash or burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea.

Inhalation: Major route of potential exposure. May cause headache, respiratory tract irritation, or central nervous system depression.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

### FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

### TOXICITY:

Chronic Toxicity: This material or its emissions may affect pregnancy or fetal development.

## 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

## 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately.

Large Spills: Contain liquid and transfer to closed containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Dispose in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

## 8. HANDLING PRECAUTIONS:

Ventilation: Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

## 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repack this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: March 5, 1996.

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix C**

### **MSDS for Alternative NMP/Soy Gold Stripper CAE6**

# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE6 INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Cyclic Amide, Alkyl Methyl Ester, Aliphatic Solvent Blend  
Trade Name: Benco Experimental Stripper CAE6  
DOT Hazard Classification: Not a DOT Hazardous Material

## 2. HAZARDOUS COMPONENTS:

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
N-Methyl-2-Pyrrolidone	N/A	N/A	50-65
Aliphatic Petroleum Distillates	100 ppm	100 ppm	15-25
Alkyl Methyl Esters	N/A	N/A	15-25

NOTE: None of these ingredients are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees.

## 3. PHYSICAL DATA:

Boiling Point:	329F (Initial)	Vapor Pressure:	<10 mm Hg
Vapor Density:	Greater than Air	Percent Volatile:	>95.0%
Specific Gravity	1.01	VOC Content:	672 grams/liter

Odor: Mild solvent odor

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: >140F Lower Explosive Limit: Unknown

Extinguishing Media: Water Fog

Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above 140F. Lower temperatures decrease the difficulty of ignition.

Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

Effects of Overexposure:

Eyes: Can cause irritation and slight corneal injury. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a rash or burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea.

Inhalation: Major route of potential exposure. May cause headache, respiratory tract irritation, or central nervous system depression.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water. Lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

TOXICITY:

Chronic Toxicity: This material or its emissions may affect pregnancy or fetal development.

## 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

## 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately.

Large Spills: Contain liquid and transfer to closed containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Dispose in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

## 8. HANDLING PRECAUTIONS:

Ventilation: Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

## 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repack this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: May 31, 2000.

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix D**

### **MSDS for Alternative Soy Gold/TBAC Stripper CAE8**



# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE8 INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Alkyl Methyl Ester, Aliphatic Solvent, Ester Blend  
Trade Name: Benco Experimental Stripper CAE8  
DOT Hazard Classification: Not a DOT Hazardous Material

## 2. HAZARDOUS COMPONENTS:

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Alkyl Methyl Esters	N/A	N/A	50-65
Tert-Butyl Acetate	150 ppm	150 ppm	15-25
Methanol	200 ppm	200 ppm	5-15
Biodegradable Wetting Agents	N/A	N/A	1-5

NOTE: None of these ingredients are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees.

## 3. PHYSICAL DATA:

Boiling Point:	205F (Initial)	Vapor Pressure:	<10 mm Hg
Vapor Density:	Greater than Air	Percent Volatile:	>95.0%
Specific Gravity:	.85	VOC Content:	79 grams/liter
Odor:	Mild solvent odor		

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: >140F Lower Explosive Limit: Unknown  
Extinguishing Media: Water Fog  
Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above 140F. Lower temperatures decrease the difficulty of ignition.  
Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

### Effects of Overexposure:

Eyes: Can cause irritation and slight corneal injury. Injury intensifies with extended contact.  
Skin: Prolonged or repeated exposure will cause a rash or burn. The burn will intensify with extended contact.  
Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.  
Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea.  
Inhalation: Major route of potential exposure. May cause headache, respiratory tract irritation, or central nervous system depression.  
Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.  
Drinking alcohol before or after exposure to solvents may cause undesirable effects.

### FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.  
Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.  
Ingestion: Call physician, poison control center, or hospital emergency room immediately.  
Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

## 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.  
Stability: Stable  
Incompatibility: Avoid contact with strong oxidizing agents.

## 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:  
Small Spills: Mop up, wipe up, or soak up immediately.  
Large Spills: Contain liquid and transfer to closed containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.  
Disposal Method: Dispose in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

## 8. HANDLING PRECAUTIONS:

Ventilation: Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications.  
Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.  
Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.  
Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.  
Safety Shower and Eyewash Station should be available in work area.

## 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repackage this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: May 31, 2000.

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix E**

### **MSDS for Alternative Low-METH NMP Stripper B25**

**MATERIAL SAFETY DATA SHEET**  
 Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557  
 Emergency Phone: 931-484-9578  
 Product Name: **BENCO #B25 INDUSTRIAL PAINT REMOVER**

1. **PRODUCT INFORMATION:**

General or Generic ID: Chlorinated Hydrocarbon, Alcohol, Acetylenic Chemical Blend  
 Trade Name: Benco #B7  
 DOT Hazard Classification: Paint Related Material, 8, UN3066, II

2. **HAZARDOUS COMPONENTS:**

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Dichloromethane	25 ppm	25 ppm	40-50
N-Methyl-2-Pyrrolidone	N/A	N/A	20-30
Methanol	200 ppm	200 ppm	8-15
2-Butoxyethanol	50 ppm	25 ppm	1-10
2-Methoxymethylethoxypropanol	25 ppm	25 ppm	1-10
Biodegradable Wetting Agents & Wax	N/A	N/A	1-5

NOTE: Dichloromethane and Methanol are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees. Please call Benco regarding reporting quantities at 800-632-3626.

3. **PHYSICAL DATA:**

Boiling Point:	104F (Initial)	Vapor Pressure:	<300 mm Hg
Vapor Density:	2.93 (Air=1)	Percent Volatile:	>97.0%
Specific Gravity:	1.15	VOC Content:	291 grams/l

Odor: Typical Methylene Chloride

4. **FIRE AND EXPLOSION HAZARD DATA:**

Flash Point: None to boiling point      Lower Explosive Limit: Unknown  
 Extinguishing Media: Water Fog  
 Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above ambient. Lower temperatures decrease the difficulty of ignition.  
 Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

5. **HEALTH HAZARD DATA:**

Effects of Overexposure:

Eyes: Can cause severe irritation and slight corneal injury. Vapors may also irritate eyes. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea, blindness, and even death. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

Inhalation: Major route of potential exposure. Dichloromethane depresses the central nervous system. Concentrations between 900-1,000 ppm may cause dizziness or drunkenness. Nausea, headache, and vomiting can occur at concentrations above 2,000 ppm. At 7,000 ppm, numbness and tingling in arms and legs and rapid heartbeat have occurred. Loss of consciousness and death have occurred at levels above 9,000 ppm, if exposure is prolonged. Carboxyhemoglobin levels can be elevated in persons exposed to Dichloromethane and can cause a substantial stress on the cardiovascular system. This elevation can be additive to the increase caused by smoking and other carbon monoxide sources.

Medical Conditions Aggravated by Exposure: Alcoholism, acute and chronic liver disease, chronic lung disease, or rhythm disorders of the heart.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

**FIRST AID:**

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

NOTE TO PHYSICIAN: This product can induce cardiac sensitization to circulating epinephrine-like compounds. Do not administer adrenaline or similar sympathomimetic drugs for 24 hours following potentially toxic exposures.

**TOXICITY:**

Chronic Toxicity: The findings of chronic toxic affects in laboratory animals may indicate toxicity to humans. Overexposure should be avoided.

Failure to do so could result in injury, illness, or even death.

This material or its emissions may affect pregnancy or fetal development.

The State of California has listed Dichloromethane under Proposition 65 as a chemical known to the State to cause cancer. Epidemiology studies of 751 humans chronically exposed to dichloromethane in the workplace of which 252 were exposed a minimum of 20 years did not demonstrate any increase in deaths caused by cancer or cardiac problems. A second study of 2,227 workers confirmed these results.

# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #B25 INDUSTRIAL PAINT REMOVER** - Page 2

## 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products: Open flames and welding arcs can cause thermal degradation with the evolution of hydrogen chloride and very small amounts of phosgene and chlorine.

## 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately. Remove to out of doors.

Large Spills: Evacuate area. Contain liquid and transfer to closed metal or polyethylene containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Evaporate small quantities in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

Reportable Quantity (RQ) is 1,250 lb. Notify National Response Center at 800-424-8802 of uncontrolled spills in excess of reportable quantity.

## 8. HANDLING PRECAUTIONS:

Ventilation: Controlling airborne concentrations below the ACGIH TLV exposure guideline is recommended. ACGIH TWA is 50 ppm. OSHA PEL is 25 ppm 8 hour TWA, and a STEL of 125 ppm. This rule also establishes an Action Level of 12.5 ppm. Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications. Lethal concentrations may exist in areas with poor ventilation. Contact Benco for further information. Medical monitoring is also required by OSHA for applications that exceed the Action Level of 12.5 ppm.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guideline. If this level is exceeded, use an approved air purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive pressure self-contained breathing apparatus.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

SARA Title III Hazard Categories - Immediate Health, Delayed Health.

## 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits and degreasers, storage tanks, and other confined areas. Do not enter those areas where vapors of this product are suspected unless special breathing apparatus is used and an observer is present for assistance. Do not use this product in a tank or vat where the product level is 12" from the top of the tank. Lethal concentrations of vapors occur in tanks and every effort should be made to keep from breathing below or near the top level of the tank.

Do not pressure product out of container with air. When opening bung, open bung partially and vent any accumulated pressure before removing bung completely. Empty product containers may contain liquid or vapor residues of this product. All precautions suggested in this Data Sheet apply to empty containers also. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repackage this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not use this product in areas where contact of vapors with gas flames or hot electric elements can occur. Please call Benco at 800-632-3626 for advice on proper heating systems. Contact with flames or hot electric elements can produce hydrochloric acid and phosgene fumes which can be fatal.

Overexposure to this product can raise the level of carbon monoxide in the blood causing cardiovascular stress.

Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: June 1, 1999.

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix F**

### **MSDS for Alternative Low-METH TBAC Stripper CAE2**

# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 49, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE2 INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Chlorinated Hydrocarbon, Alcohol, Ester Chemical Blend

Trade Name: Benco #CAE2 Experimental Stripper

DOT Hazard Classification: Paint Related Material, 8, UN3066, II

## 2. HAZARDOUS COMPONENTS:

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Dichloromethane	25 ppm	25 ppm	40-50
Tert-Butyl Acetate	150 ppm	150 ppm	20-30
Methanol	200 ppm	200 ppm	8-15
2-Butoxyethanol	50 ppm	25 ppm	1-10
2-Methoxymethylethoxypropanol	25 ppm	25 ppm	1-10
Biodegradable Wetting Agents & Wax	N/A	N/A	1-5

NOTE: Dichloromethane and Methanol are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees. Please call Benco regarding reporting quantities at 800-632-3626.

## 3. PHYSICAL DATA:

Boiling Point:	104°F (Initial)	Vapor Pressure:	<300 mm Hg
Vapor Density:	2.93 (Air=1)	Percent Volatile:	>97.0%
Specific Gravity:	1.16	VOC Content:	144 grams/l
Odor:	Typical Methylene Chloride		

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: None to boiling point      Lower Explosive Limit: Unknown

Extinguishing Media: Water Fog

Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above ambient. Lower temperatures decrease the difficulty of ignition.

Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

### Effects of Overexposure:

Eyes: Can cause severe irritation and slight corneal injury. Vapors may also irritate eyes. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a burn. The burn will intensify with extended contact.

Skin: Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea, blindness, and even death. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

Inhalation: Major route of potential exposure. Dichloromethane depresses the central nervous system. Concentrations between 900-1,000 ppm may cause dizziness or drunkenness. Nausea, headache, and vomiting can occur at concentrations above 2,000 ppm. At 7,000 ppm, numbness and tingling in arms and legs and rapid heartbeat have occurred. Loss of consciousness and death have occurred at levels above 9,000 ppm, if exposure is prolonged. Carboxyhemoglobin levels can be elevated in persons exposed to Dichloromethane and can cause a substantial stress on the cardiovascular system. This elevation can be additive to the increase caused by smoking and other carbon monoxide sources.

Medical Conditions Aggravated by Exposure: Alcoholism, acute and chronic liver disease, chronic lung disease, or rhythm disorders of the heart.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

### FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

NOTE TO PHYSICIAN: This product can induce cardiac sensitization to circulating epinephrine-like compounds. Do not administer adrenaline or similar sympathomimetic drugs for 24 hours following potentially toxic exposures.

### TOXICITY:

Chronic Toxicity: The findings of chronic toxic effects in laboratory animals may indicate toxicity to humans. Overexposure should be avoided.

Failure to do so could result in injury, illness, or even death.

This material or its emissions may affect pregnancy or fetal development.

The State of California has listed Dichloromethane under Proposition 65 as a chemical known to the State to cause cancer. Epidemiology studies of 751 humans chronically exposed to dichloromethane in the workplace of which 252 were exposed a minimum of 20 years did not demonstrate any increase in deaths caused by cancer or cardiac problems. A second study of 2,227 workers confirmed these results.

## MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE2 INDUSTRIAL PAINT REMOVER** - Page 2

### 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products: Open flames and welding arcs can cause thermal degradation with the evolution of hydrogen chloride and very small amounts of phosgene and chlorine.

### 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately. Remove to out of doors.

Large Spills: Evacuate area. Contain liquid and transfer to closed metal or polyethylene containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Evaporate small quantities in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

Reportable Quantity (RQ) is 1,250 lb. Notify National Response Center at 800-424-8802 of uncontrolled spills in excess of reportable quantity.

### 8. HANDLING PRECAUTIONS:

Ventilation: Controlling airborne concentrations below the ACGIH TLV exposure guideline is recommended. ACGIH TWA is 50 ppm. OSHA PEL is 25 ppm 8 hour TWA, and a STEL of 125 ppm. This rule also establishes an Action Level of 12.5 ppm. Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications. Lethal concentrations may exist in areas with poor ventilation. Contact Benco for further information. Medical monitoring is also required by OSHA for applications that exceed the Action Level of 12.5 ppm.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guideline. If this level is exceeded, use an approved air purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive pressure self-contained breathing apparatus.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

SARA Title III Hazard Categories - Immediate Health, Delayed Health.

### 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits and degreasers, storage tanks, and other confined areas. Do not enter those areas where vapors of this product are suspected unless special breathing apparatus is used and an observer is present for assistance. Do not use this product in a tank or vat where the product level is 12" from the top of the tank. Lethal concentrations of vapors occur in tanks and every effort should be made to keep from breathing below or near the top level of the tank.

Do not pressure product out of container with air. When opening bung, open bung partially and vent any accumulated pressure before removing bung completely. Empty product containers may contain liquid or vapor residues of this product. All precautions suggested in this Data Sheet apply to empty containers also. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repackage this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not use this product in areas where contact of vapors with gas flames or hot electric elements can occur. Please call Benco at 800-632-3626 for advice on proper heating systems. Contact with flames or hot electric elements can produce hydrochloric acid and phosgene fumes which can be fatal.

Overexposure to this product can raise the level of carbon monoxide in the blood causing cardiovascular stress.

Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: May 17, 2000..

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix G**

### **MSDS for Alternative Low-METH Soy Gold Stripper CAE3**



# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE3 INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Chlorinated Hydrocarbon, Alcohol, Alkyl Methyl Ester Chemical Blend

Trade Name: Benco #CAE3 Experimental Stripper

DOT Hazard Classification: Paint Related Material, 8, UN3066, II

## 2. HAZARDOUS COMPONENTS:

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Dichloromethane	25 ppm	25 ppm	40-50
Alkyl Methyl Esters	N/A	N/A	20-30
Methanol	200 ppm	200 ppm	8-15
2-Butoxyethanol	50 ppm	25 ppm	1-10
2-Methoxymethylethoxypropanol	25 ppm	25 ppm	1-10
Biodegradable Wetting Agents & Wax	N/A	N/A	1-5

NOTE: Dichloromethane and Methanol are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees. Please call Benco regarding reporting quantities at 800-632-3626.

## 3. PHYSICAL DATA:

Boiling Point:	104F (Initial)	Vapor Pressure:	<300 mm Hg
Vapor Density:	2.93 (Air=1)	Percent Volatile:	>97.0%
Specific Gravity	1.16	VOC Content:	142 grams/l
Odor: Typical Methylene Chloride			

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: None to boiling point Lower Explosive Limit: Unknown

Extinguishing Media: Water Fog

Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above ambient. Lower temperatures decrease the difficulty of ignition.

Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

Effects of Overexposure:

Eyes: Can cause severe irritation and slight corneal injury. Vapors may also irritate eyes. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea, blindness, and even death. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

Inhalation: Major route of potential exposure. Dichloromethane depresses the central nervous system. Concentrations between 900-1,000 ppm may cause dizziness or drunkenness. Nausea, headache, and vomiting can occur at concentrations above 2,000 ppm. At 7,000 ppm, numbness and tingling in arms and legs and rapid heartbeat have occurred. Loss of consciousness and death have occurred at levels above 9,000 ppm, if exposure is prolonged. Carboxyhemoglobin levels can be elevated in persons exposed to Dichloromethane and can cause a substantial stress on the cardiovascular system. This elevation can be additive to the increase caused by smoking and other carbon monoxide sources.

Medical Conditions Aggravated by Exposure: Alcoholism, acute and chronic liver disease, chronic lung disease, or rhythm disorders of the heart.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

NOTE TO PHYSICIAN: This product can induce cardiac sensitization to circulating epinephrine-like compounds. Do not administer adrenaline or similar sympathomimetic drugs for 24 hours following potentially toxic exposures.

TOXICITY:

Chronic Toxicity: The findings of chronic toxic affects in laboratory animals may indicate toxicity to humans. Overexposure should be avoided.

Failure to do so could result in injury, illness, or even death.

This material or its emissions may affect pregnancy or fetal development.

The State of California has listed Dichloromethane under Proposition 65 as a chemical known to the State to cause cancer. Epidemiology studies of 751 humans chronically exposed to dichloromethane in the workplace of which 252 were exposed a minimum of 20 years did not demonstrate any increase in deaths caused by cancer or cardiac problems. A second study of 2,227 workers confirmed these results.

## MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE3 INDUSTRIAL PAINT REMOVER** - Page 2

### 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products: Open flames and welding arcs can cause thermal degradation with the evolution of hydrogen chloride and very small amounts of phosgene and chlorine.

### 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately. Remove to out of doors.

Large Spills: Evacuate area. Contain liquid and transfer to closed metal or polyethylene containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Evaporate small quantities in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

Reportable Quantity (RQ) is 1,250 lb. Notify National Response Center at 800-424-8802 of uncontrolled spills in excess of reportable quantity.

### 8. HANDLING PRECAUTIONS:

Ventilation: Controlling airborne concentrations below the ACGIH TLV exposure guideline is recommended. ACGIH TWA is 50 ppm. OSHA PEL is 25 ppm 8 hour TWA, and a STEL of 125 ppm. This rule also establishes an Action Level of 12.5 ppm. Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications. Lethal concentrations may exist in areas with poor ventilation. Contact Benco for further information. Medical monitoring is also required by OSHA for applications that exceed the Action Level of 12.5 ppm.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guideline. If this level is exceeded, use an approved air purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive pressure self-contained breathing apparatus.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

SARA Title III Hazard Categories - Immediate Health, Delayed Health.

### 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits and degreasers, storage tanks, and other confined areas. Do not enter those areas where vapors of this product are suspected unless special breathing apparatus is used and an observer is present for assistance. Do not use this product in a tank or vat where the product level is 12" from the top of the tank. Lethal concentrations of vapors occur in tanks and every effort should be made to keep from breathing below or near the top level of the tank.

Do not pressure product out of container with air. When opening bung, open bung partially and vent any accumulated pressure before removing bung completely. Empty product containers may contain liquid or vapor residues of this product. All precautions suggested in this Data Sheet apply to empty containers also. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repackage this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not use this product in areas where contact of vapors with gas flames or hot electric elements can occur. Please call Benco at 800-632-3626 for advice on proper heating systems. Contact with flames or hot electric elements can produce hydrochloric acid and phosgene fumes which can be fatal.

Overexposure to this product can raise the level of carbon monoxide in the blood causing cardiovascular stress.

Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: May 17, 2000..

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix H**

### **MSDS for Alternative Low-METH Propylene Carbonate Stripper CAE4**

# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE4 INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Chlorinated Hydrocarbon, Alcohol, Ester Blend  
Trade Name: Benco #CAE4 Experimental Stripper  
DOT Hazard Classification: Paint Related Material, 8, UN3066, II

## 2. HAZARDOUS COMPONENTS:

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Dichloromethane	25 ppm	25 ppm	40-50
1,3-dioxolan-2-one, methyl-	N/A	N/A	20-30
Methanol	200 ppm	200 ppm	8-15
2-Butoxyethanol	50 ppm	25 ppm	1-10
2-Methoxymethylethoxypropanol	25 ppm	25 ppm	1-10
Biodegradable Wetting Agents & Wax	N/A	N/A	1-5

NOTE: Dichloromethane and Methanol are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees. Please call Benco regarding reporting quantities at 800-632-3626.

## 3. PHYSICAL DATA:

Boiling Point:	104F (Initial)	Vapor Pressure:	<300 mm Hg
Vapor Density:	2.93 (Air=1)	Percent Volatile:	>97.0%
Specific Gravity	1.17	VOC Content:	352 grams/l
Odor: Typical Methylene Chloride			

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: None to boiling point      Lower Explosive Limit: Unknown  
Extinguishing Media: Water Fog  
Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above ambient. Lower temperatures decrease the difficulty of ignition.  
Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

### Effects of Overexposure:

Eyes: Can cause severe irritation and slight corneal injury. Vapors may also irritate eyes. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea, blindness, and even death. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

Inhalation: Major route of potential exposure. Dichloromethane depresses the central nervous system. Concentrations between 900-1,000 ppm may cause dizziness or drunkenness. Nausea, headache, and vomiting can occur at concentrations above 2,000 ppm. At 7,000 ppm, numbness and tingling in arms and legs and rapid heartbeat have occurred. Loss of consciousness and death have occurred at levels above 9,000 ppm, if exposure is prolonged. Carboxyhemoglobin levels can be elevated in persons exposed to Dichloromethane and can cause a substantial stress on the cardiovascular system. This elevation can be additive to the increase caused by smoking and other carbon monoxide sources.

Medical Conditions Aggravated by Exposure: Alcoholism, acute and chronic liver disease, chronic lung disease, or rhythm disorders of the heart.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

### FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

NOTE TO PHYSICIAN: This product can induce cardiac sensitization to circulating epinephrine-like compounds. Do not administer adrenaline or similar sympathomimetic drugs for 24 hours following potentially toxic exposures.

### TOXICITY:

Chronic Toxicity: The findings of chronic toxic affects in laboratory animals may indicate toxicity to humans. Overexposure should be avoided.

Failure to do so could result in injury, illness, or even death.

This material or its emissions may affect pregnancy or fetal development.

The State of California has listed Dichloromethane under Proposition 65 as a chemical known to the State to cause cancer. Epidemiology studies of 751 humans chronically exposed to dichloromethane in the workplace of which 252 were exposed a minimum of 20 years did not demonstrate any increase in deaths caused by cancer or cardiac problems. A second study of 2,227 workers confirmed these results.

## MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE4 INDUSTRIAL PAINT REMOVER** - Page 2

### 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products: Open flames and welding arcs can cause thermal degradation with the evolution of hydrogen chloride and very small amounts of phosgene and chlorine.

### 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately. Remove to out of doors.

Large Spills: Evacuate area. Contain liquid and transfer to closed metal or polyethylene containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Evaporate small quantities in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

Reportable Quantity (RQ) is 1,250 lb. Notify National Response Center at 800-424-8302 of uncontrolled spills in excess of reportable quantity.

### 8. HANDLING PRECAUTIONS:

Ventilation: Controlling airborne concentrations below the ACGIH TLV exposure guideline is recommended. ACGIH TWA is 50 ppm. OSHA PEL is 25 ppm 8 hour TWA, and a STEL of 125 ppm. This rule also establishes an Action Level of 12.5 ppm. Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications. Lethal concentrations may exist in areas with poor ventilation. Contact Benco for further information. Medical monitoring is also required by OSHA for applications that exceed the Action Level of 12.5 ppm.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guideline. If this level is exceeded, use an approved air purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive pressure self-contained breathing apparatus.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

SARA Title III Hazard Categories - Immediate Health, Delayed Health.

### 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits and degreasers, storage tanks, and other confined areas. Do not enter those areas where vapors of this product are suspected unless special breathing apparatus is used and an observer is present for assistance. Do not use this product in a tank or vat where the product level is 12" from the top of the tank. Lethal concentrations of vapors occur in tanks and every effort should be made to keep from breathing below or near the top level of the tank.

Do not pressure product out of container with air. When opening bung, open bung partially and vent any accumulated pressure before removing bung completely. Empty product containers may contain liquid or vapor residues of this product. All precautions suggested in this Data Sheet apply to empty containers also. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repack this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not use this product in areas where contact of vapors with gas flames or hot electric elements can occur. Please call Benco at 800-632-3626 for advice on proper heating systems. Contact with flames or hot electric elements can produce hydrochloric acid and phosgene fumes which can be fatal.

Overexposure to this product can raise the level of carbon monoxide in the blood causing cardiovascular stress.

Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: May 17, 2000..

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.

## **Appendix I**

### **MSDS for Alternative Low-METH NMP/TBAC/Soy Gold Stripper CAE7**

# MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE7 INDUSTRIAL PAINT REMOVER**

## 1. PRODUCT INFORMATION:

General or Generic ID: Chlorinated Hydrocarbon, Cyclic Amide, Aromatic Solvent, Ester Chemical Blend  
Trade Name: Benco #CAE7 Experimental Stripper  
DOT Hazard Classification: Paint Related Material, 8, UN3066, II

## 2. HAZARDOUS COMPONENTS:

INGREDIENT	PEL(OSHA)	TWA(OSHA)	APPROX%
Dichloromethane	25 ppm	25 ppm	40-50
Tert-Butyl Acetate	150 ppm	150 ppm	8-15
N-Methyl-2-Pyrrolidone	N/A	N/A	8-15
Alkyl Methyl Esters	N/A	N/A	8-15
Methanol	200 ppm	200 ppm	8-15
Biodegradable Wetting Agents & Wax	N/A	N/A	1-5

NOTE: Dichloromethane and Methanol are subject to reporting requirements of Section 313 of Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) and 40CFR Part 372, which apply to businesses with 10 or more employees. Please call Benco regarding reporting quantities at 800-632-3626.

## 3. PHYSICAL DATA:

Boiling Point:	10-4F (Initial)	Vapor Pressure:	<300 mm Hg
Vapor Density:	2.93 (-Air=1)	Percent Volatile:	>97.0%
Specific Gravity	1.15	VOC Content:	125 grams/l
Odor: Typical Methylene Chloride			

## 4. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: None to boiling point      Lower Explosive Limit: Unknown  
Extinguishing Media: Water Fog  
Fire and Explosion Hazards: May form flammable vapor-air mixtures at temperatures above ambient. Lower temperatures decrease the difficulty of ignition.  
Special Firefighting Procedures: Self-Contained Breathing Apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

## 5. HEALTH HAZARD DATA:

### Effects of Overexposure:

Eyes: Can cause severe irritation and slight corneal injury. Vapors may also irritate eyes. Injury intensifies with extended contact.

Skin: Prolonged or repeated exposure will cause a burn. The burn will intensify with extended contact.

Skin Absorption: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting, diarrhea, blindness, and even death. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

Inhalation: Major route of potential exposure. Dichloromethane depresses the central nervous system. Concentrations between 900-1,000 ppm may cause dizziness or drunkenness. Nausea, headache, and vomiting can occur at concentrations above 2,000 ppm. At 7,000 ppm, numbness and tingling in arms and legs and rapid heartbeat have occurred. Loss of consciousness and death have occurred at levels above 9,000 ppm, if exposure is prolonged. Carboxyhemoglobin levels can be elevated in persons exposed to Dichloromethane and can cause a substantial stress on the cardiovascular system. This elevation can be additive to the increase caused by smoking and other carbon monoxide sources.

Medical Conditions Aggravated by Exposure: Alcoholism, acute and chronic liver disease, chronic lung disease, or rhythm disorders of the heart.

Notice: Reports have associated repeated and prolonged exposure to solvents to permanent brain and nervous system damage. Persons thought to have heart or respiratory problems should seek medical advice before using solvents of any kind. If signs of allergy develop (breathing difficulty, eye itching, prolonged itching and redness of the skin, headaches, dizziness, etc.) discontinue use of this product immediately and consult a physician.

Drinking alcohol before or after exposure to solvents may cause undesirable effects.

### FIRST AID:

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.

Eyes: Flush with large amounts of water, lifting upper and lower lids occasionally. Get medical attention.

Ingestion: Call physician, poison control center, or hospital emergency room immediately.

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer respiration. Keep person warm, quiet, and get medical attention.

NOTE TO PHYSICIAN: This product can induce cardiac sensitization to circulating epinephrine-like compounds. Do not administer adrenaline or similar sympathomimetic drugs for 24 hours following potentially toxic exposures.

### TOXICITY:

Chronic Toxicity: The findings of chronic toxic affects in laboratory animals may indicate toxicity to humans. Overexposure should be avoided.

Failure to do so could result in injury, illness, or even death.

This material or its emissions may affect pregnancy or fetal development.

The State of California has listed Dichloromethane under Proposition 65 as a chemical known to the State to cause cancer. Epidemiology studies of 751 humans chronically exposed to dichloromethane in the workplace of which 252 were exposed a minimum of 20 years did not demonstrate any increase in deaths caused by cancer or cardiac problems. A second study of 2,227 workers confirmed these results.

## MATERIAL SAFETY DATA SHEET

Benco Sales, Inc., P.O. Box 3649, Crossville, TN 38557

Emergency Phone: 931-484-9578

Product Name: **BENCO #CAE7 INDUSTRIAL PAINT REMOVER** - Page 2

### 6. REACTIVITY DATA:

Hazardous Polymerization: Can not occur.

Stability: Stable

Incompatibility: Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products: Open flames and welding arcs can cause thermal degradation with the evolution of hydrogen chloride and very small amounts of phosgene and chlorine.

### 7. SPILL OR LEAK PROCEDURES:

Action to take for spills or leaks:

Small Spills: Mop up, wipe up, or soak up immediately. Remove to out of doors.

Large Spills: Evacuate area. Contain liquid and transfer to closed metal or polyethylene containers. Avoid contamination of ground and surface waters. If spill occurs indoors, turn off air conditioning and/or heating system to prevent vapors from contaminating entire building.

Disposal Method: Evaporate small quantities in compliance with local, state, and federal regulations. Do not dispose of this material or any waste residue into septic systems, storm drains, or directly onto the ground.

Reportable Quantity (RQ) is 1,250 lb. Notify National Response Center at 800-424-8802 of uncontrolled spills in excess of reportable quantity.

### 8. HANDLING PRECAUTIONS:

Ventilation: Controlling airborne concentrations below the ACGIH TLV exposure guideline is recommended. ACGIH TWA is 50 ppm. OSHA PEL is 25 ppm 8 hour TWA and a STEL of 125 ppm. This rule also establishes an Action Level of 12.5 ppm. Use only with adequate ventilation. Local exhaust ventilation is necessary for most applications. Lethal concentrations may exist in areas with poor ventilation. Contact Benco for further information. Medical monitoring is also required by OSHA for applications that exceed the Action Level of 12.5 ppm.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guideline. If this level is exceeded, use an approved air purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive pressure self-contained breathing apparatus.

Skin Protection: Wear chemical resistant rubber gloves, apron, boots, and plastic arm sleeves.

Eye Protection: Use safety glasses. Where contact is likely, use chemical splash goggles.

Hygiene: Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom. Any clothing or shoes that have been contaminated should be removed immediately and thoroughly laundered before wearing again.

Safety Shower and Eyewash Station should be available in work area.

SARA Title III Hazard Categories - Immediate Health, Delayed Health.

### 9. ADDITIONAL INFORMATION:

Special Precautions to be Taken in Handling & Storage: Exercise reasonable care and caution. Avoid breathing vapors. Store in a cool place out of direct sunlight. Concentrated vapors of this product are heavier than air and will collect in low areas such as pits and degreasers, storage tanks, and other confined areas. Do not enter those areas where vapors of this product are suspected unless special breathing apparatus is used and an observer is present for assistance. Do not use this product in a tank or vat where the product level is 12" from the top of the tank. Lethal concentrations of vapors occur in tanks and every effort should be made to keep from breathing below or near the top level of the tank.

Do not pressure product out of container with air. When opening bung, open bung partially and vent any accumulated pressure before removing bung completely. Empty product containers may contain liquid or vapor residues of this product. All precautions suggested in this Data Sheet apply to empty containers also. Empty containers are property of Benco Sales, Inc. and should not be sold to individuals or other parties. Do not repackage this product for resale. Any product purchased for resale must have this MSDS attached to each container and must be in original container. If each container does not have an MSDS, call Benco at 800-632-3626. Do not use this product in areas where contact of vapors with gas flames or hot electric elements can occur. Please call Benco at 800-632-3626 for advice on proper heating systems. Contact with flames or hot electric elements can produce hydrochloric acid and phosgene fumes which can be fatal.

Overexposure to this product can raise the level of carbon monoxide in the blood causing cardiovascular stress.

Do not remove or deface labels off containers.

This Material Safety Data Sheet supersedes any previous Material Safety Data Sheet on this product. Effective Date: May 17, 2000.

The information accumulated herein is given in good faith and believed to be accurate, but no warranty, express or implied, of merchantability, fitness, or otherwise is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all inclusive nor fully adequate in every circumstance. Consult Benco Sales, Inc. for proper handling procedures in specific situations or for any further information.



**Appendix J**  
**SCAQMD Modeling Calculations for Strip Joint**

**Table 2**

Dispersion Factors (X/Q) Values ( $[\mu\text{g}/\text{m}^3]/[\text{tons}/\text{yr}]$ )  
 For Existing Scenario (1 stack and 1 volume source) at Redondo Beach Strip Joint

Emission Rates by Percent		Downwind distance (meters)							
Stack	Volume	25	50	75	100	200	300	500	1000
100%	0%	14.43	7.78	4.10	2.45	0.65	0.29	0.11	0.03
80%	20%	15.60	7.67	4.00	2.39	0.64	0.29	0.10	0.03
50%	50%	17.35	7.51	3.87	2.31	0.62	0.28	0.10	0.03
20%	80%	19.11	7.34	3.73	2.24	0.61	0.28	0.10	0.03
0%	100%	20.28	7.23	3.64	2.18	0.60	0.28	0.10	0.03

**Table 3**

Dispersion Factors (X/Q) Values ( $[\mu\text{g}/\text{m}^3]/[\text{tons}/\text{yr}]$ )  
 For Improved Ventilation Scenario (2 stacks and 1 volume source)  
 at Redondo Beach Strip Joint

Downwind distance (meters)							
25	50	75	100	200	300	500	1000
14.64	7.59	3.99	2.39	0.64	0.29	0.10	0.03

Note: Table 1 in SCAQMD not needed for analysis

Source: South Coast Air Quality Management District "Risk Assessment Module for Furniture Stripping Operations," June 2, 1998.